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THE BUSINESS OUTLOOK.

The electrical trade has reason to congratulate itself on the outlook for business during the coming fall and winter. In the period just passed the electrical industry has held its own better than any other. While progress in this field may not have been as rapid as under more favorable conditions, there has been a healthy and conservative growth, which is now making itself apparent under the effects of returning prosperity. The almost universal failure of the foreign crop and the abundance of our own have resulted in a marked advance in prices, and exceptionally large exportations are now being and will continue to be made for many months. The large sums which will come from abroad to pay for these exports will make money plentiful in this country, and cannot fail to stimulate trade in all lines. The steady and persistent upward tendency in the prices of securities tells its own story.

The recent tariff legislation has inspired a feeling of confidence as to the conditions that will be likely to prevail for some time to come, and the large amount of capital now lying idle will be quick to take advantage of the situation to seek investment. The remunerative returns which are possible from investments in electrical enterprises will attract large amounts of this capital into the electrical field. An increasing foreign demand for machinery has been noticeable for some months past, during which the amount exported has been exceptionally large.

After experiencing the unsatisfactory results of ruinous competition and cutting of prices which prevailed for some years, manufacturers in the electrical field have seen the wisdom of maintaining a fair scale of prices, which will enable them to receive an adequate return for the capital and labor employed in the conduct of their enterprises. The encouraging character of the regular correspondence received at the office of THE ELECTRICAL WORLD, coupled with the results of our personal inquiry and investigations among the electrical trade, encourages us in the belief that with the exercise of prudent and conservative business methods, born of the recently experienced depression, the coming season will witness a most healthy and profitable expansion of the electrical trade, with the correspondingly resulting benefit to manufacturers and others whose efforts must contribute to it.

A WIRELESS TELEGRAPH COMPANY.

Our English correspondent makes mention of the organization of a company in London, the Wireless Telegraph & Signal Company, to exploit the system of wireless telegraphy invented by Signor Marconi.

It appears questionable if Marconi really owns a master patent on his system, for the very good reason that the principles underlying its operation are well known to electricians. In producing results he uses in combination certain apparatus which were devised and used by others before him, and whatever patent he may hold cannot cover much more than a combination of apparatus used previously for other purposes. The use of silver electrodes and a particular vacuum in the Branly-Lodge "coherer" which Marconi uses as a component part of his receiving apparatus may be the subject of a patent, and the use of an inductive shunt in connection with the tube may also be patentable, but these, it will be understood, are matters of comparatively minor importance.

Since the method itself seems to be unpatentable, there is apparently no reason why anyone may not produce the same results by some other modification of the essential apparatus.

The commercial availability of the system, however, is an important question. Its practical value for general use seems questionable for various reasons, some of which have already been pointed out in these columns. No doubt the system will be useful for some purposes, such as communicating between light-houses and shore, and similar applications in the open, but as to its universal use in the manner of ordinary telegraph wires there exists considerable skepticism. The system may develop a peculiar field of its own, but as yet such a possibility is not apparent.

Some use for it might be found in the transmission of press dispatches all over England from London. All newspapers receive practically the same news from the news centres, and this application of the system might develop into something practical. It might be successfully used in this way, because it involves only one transmission, but where the transmissions multiply in number and direction the difficulties would probably increase enormously.

In the meantime the new company proposes to float a capital of $500,000 in $5 shares—this low price per share being no doubt for the purpose of making the enterprise popular.

ELECTRIC VEHICLES.

It is very evident to the average observer that the so-called horseless carriage is looming up as an important factor in the urban transportation problem. Animal power for the propulsion of street cars has been almost entirely superseded, in this country at least, by electro-mechanical power, and the horse seems to be threatened with further degradation by the substitution of like power for the propulsion of wagons and other vehicles in city streets.

In this city a company has taken the matter up in earnest, and is giving the public an electric cab and carriage service which for its reliability and comparative perfection is justly entitled to the support and admiration of all lovers of progress and enterprise. When it is remembered that this is the pioneer undertaking in this direction, as far as this city is concerned, the completeness of the service is praiseworthy. The traveling public has not been compelled to suffer any inconveniences attributable to faulty construction and general untrustworthiness of these vehicles, but has had, from the first, placed at its disposal electric carriages finished as to design and construction, and reliable as to mobility. In other words, all experimenting has been done at the factory, in private, and what the public is familiar with is the comparatively perfect machine. The wisdom of this course of development, from a commercial point of view, is evident from the liberal manner in which the public patronizes the enterprise.

In the conduct of this, as of any other enterprise, the all-important question is "Does it pay?" or, "Willit likely pay in the future, if not now?" The capitalist is interested in this question more than in any other, and unless there is a reasonable probability that a new venture will return a fair interest on the investment the means of carrying out the plans on a commercial basis will not be forthcoming. In this instance, however, success seems to have been foreseen at the start, and the practical operation of the business has amply confirmed the wisdom of the undertaking.

Elsewhere in this issue we publish the first part of an article on the electric-carriage service in New York City, which will no doubt be read with a great deal of interest by the technical man as well as the layman.

In preparing an article on an industry that is comparatively new and untried it is usually impossible to obtain figures that will enable the engineer, the manager and the capitalist to calculate as to whether the enterprise is or promises to be profitable. Here is an exception, however, for data are given in sufficient detail to enable anyone interested to determine that point for himself in this particular connection. In passing, it may be remarked that the showing made in this instance, where a new industry is concerned, is indeed remarkable and reflects great credit upon the promoters for their foresight; upon the engineers, for their skill in solving all the problems involved in the development of this industry, and upon the managers for the excellence of the service rendered to the public.

There is every reason to believe that the electric-vehicle industry is well established on a sure foundation, and that it will grow rapidly, especially in the estimation of the public, without which support no enterprise of a semi-public nature could long exist.

As compared with foreign productions, the American electrical vehicle has a more attractive appearance, and is more easily cared for and handled. Since 1881, when Gaston Planté made his first experiments in electric locomotion for vehicles, constant efforts have been exerted to develop a perfect type of machine, and while we in America may not have so many in operation as are found in some European cities, notably Paris, we have a machine that is certainly superior in all of the substantial qualities.

THREATENED STRIKE OF ENGLISH TELEGRAPHERS.

Late dispatches from London indicate that a strike among the telegraphers in England is threatened. They have for some time been uneasy, and the agitation finally took the form of a petition for the redress of a number of alleged grievances. The principal causes of complaint were the meagreness of salaries and compulsory overtime work without additional compensation. The demands were finally presented in due form to the Postmaster-General, who, after giving the subject proper consideration, declined to accede to the principal ones. The men asked for an increase of salary from $800 to $900 per year; this, however, was not conceded. The Postmaster-General agreed to increase the force by the addition of forty superintendents, in order to relieve the pressure of work, and to abolish the technical examinations of candidates for the senior grade. These concessions, however, do not satisfy the men, and a strike is threatened.

Those who recall the great telegraph strike in this country in 1883 may form some idea of the utter confusion and paralysis to business that would result if the English operators should leave their desks. The effects of a strike in that country would be felt all over the commercial world, for the reason that much of the international telegraph service, particularly that to and from the United States, passes through the London office.

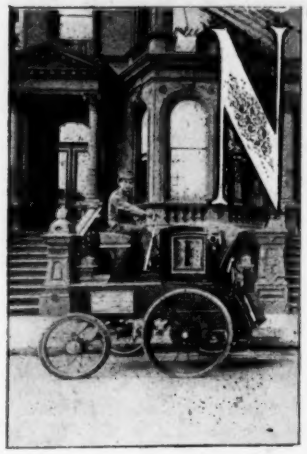
Such a strike, therefore, would be nothing short of a public calamity, and it is hoped that oil may be poured on the troubled waters, and some amicable settlement of the difficulties will be reached without any sacrifice of commercial interests.

British Association for the Advancement of Science.

This association, which will hold its next meeting in Toronto, Canada, commencing August 18 and closing August 25, has, through its Publication Committee, prepared the preliminary programme. It is in the form of a paper-bound book, and gives a large amount of information regarding the British-American possessions. The various cities and many other points of interest are illustrated and described for the guidance and information of those members who may wish to make tours throughout the country.

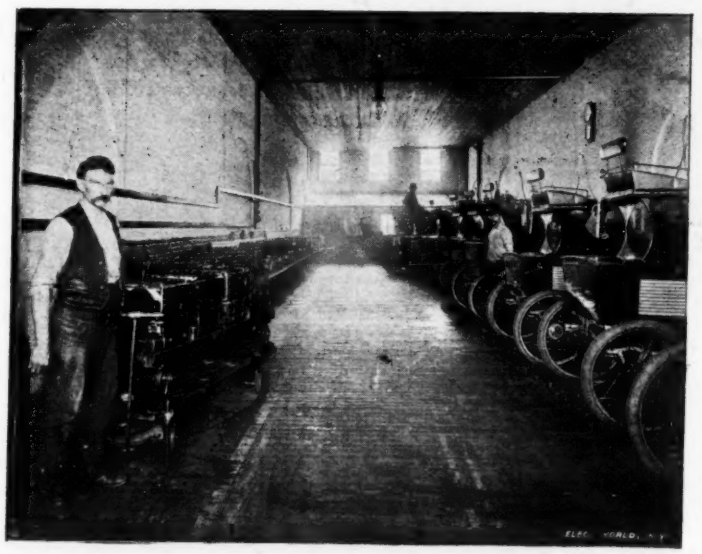
Electric Motor-Cab Service in New York City—I.

MECHANICALLY PROPELLED VEHICLES.



No modern development is fraught with greater possibilities than the motor-propelled road vehicle. We have arrived at an age in which mechanical power reigns supreme. For economical, humane, sanitary and other reasons, it must eventually take the place of animal energy for all purposes. In the development of our present methods of transportation over fixed roads the horse has been almost universally relegated to the past, and, beyond all doubt, the time when the same can be said of all other wheeled conveyances is a possibility within the life of many who, ten years ago, doubted the ultimate success of the present overhead trolley electric-street railway.

The present practically universal application of the electric motor to street-railway traction purposes has almost eradicated the fact that but a few years ago many rivals were in the field. To-day a problem of equal, if not greater, importance is the substitution of mechanical for animal energy for the propulsion of common road vehicles. Although by no means a new problem, it is only within recent years that it has attained particular prominence and attracted universal attention. Many claimants for success have appeared, and some have unquestionably indicated excellent future possibilities. European productions in this direction have rather favored vapor and steam-motor propelled vehicles. In this country it may well be said that electrically propelled motor-road vehicles have attained marked prominence and success. Although steam and gas motors have peculiar advantages as portable motor powers for this purpose, the fact remains that none of these can compete with the simplicity, flexibility, safety, freedom from disagreeable features, ease of application and control, and many other excellent features of the electric motor. It is true that the electric-motor propelled vehicle has failings, but these are entirely due to the present form of electric-current supply from lead storage batteries. This latter element probably limits the application of the electric vehicle to certain classes of work. When, however, long-traveling capacity is a secondary consideration, it can now be authentically asserted that the electric vehicle surpasses the results obtained with vehicles propelled by either steam or gas, both of which may have



BATTERY RACKS AND CABS IN STATION.

their particular field until such time as the difficulties inherent in the present portable current-supplying appliances are eliminated.

With the earliest development of the storage battery, electric-motor vehicles made their appearance. Among the pioneers in the development of such conveyances were Messrs. Morris & Salom, who almost ten years ago first experimented in this direction. The result of their work did not, however, take any prominent shape until about two years ago, when the Morris & Salom "Electro-bat" was entered in the Chicago *Times-Herald* motor-vehicle race, and was awarded first prize for superior features, although it did not even go over the entire course.

This vehicle resembles a surrey in general appearance. It is still

REPAIR SHOP AND ELECTRIC TIRE-PUMP.

in use, and forms part of the equipment to be described. The development of the ideas embodied in this conveyance resulted in the formation of theElectric Carriage & Wagon Company, which has inaugurated in New York City an electric-motor cab and carriage service. A variety of other electrically propelled conveyances have also been built, all of which, however, embody, more or less, the same general mechanical and electrical features. Stations in other cities are also to be established.

This motor-cab service and station has now been in actual service for some five months, and although no attempt is made to compete in rates with other cab service, yet the demand for electric-motor cabs has assured the success of the enterprise. This pioneer electric-cab station is said to be already on a paying basis. The

AN ELECTRIC SURREY.

New York station is in charge of Mr. C. J. Harrington, to whose energy and enterprise the success of the venture is largely due.

THE STATION.

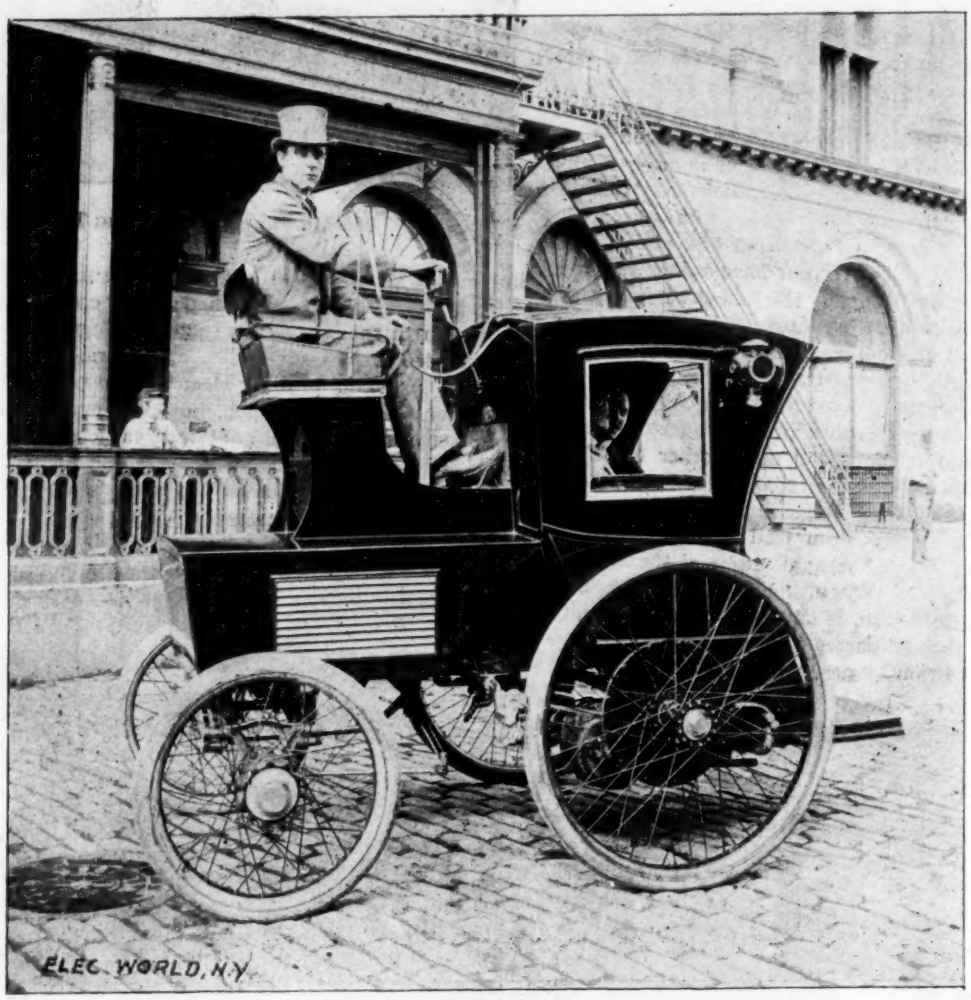
Several doors west of Broadway, on Thirty-ninth street, the station of this pioneer electric-motor cab service is located. The

building utilized for this purpose is a three-story brick structure occupying a ground space of about 40x100 feet. On the ground floor, which is shown in the illustration, are the rental office, storage-battery racks, switchboard and charging apparatus, and the cab equipment. The cabs are all placed side by side, and the batteries on the other side of the room. That section occupied by the cabs has an inclined cement floor with suitable sewer drains, so that the vehicles can be easily washed and cleaned. On the right, in front of the cabs, at the entrance to the building, is the rental office. In the rear is the switchboard room, immediately behind the battery racks.

The second floor is used as the repair department, being equipped with lead-burning furnace, electric tire pump, and suitable tools for battery, motor and vehicle repair. A section of this floor is partitioned off and used as a main office. Ample storage facilities are afforded on the top floor. This station is open at all hours. Its location could not be better for the purpose, as it is almost in the centre of New York's busiest district.

THE VEHICLES.

Twelve electric hansom cabs and the surrey previously mentioned constitute the rolling-stock equipment of this station. Aside from these, however, the Electric Carriage & Wagon Company has completed and is developing other types, among which are broughams, victorias, coaches, delivery wagons, etc. In fact, the equipment in this city is to be increased by the addition of the very handsome electric brougham here illustrated, which will be manned by a liveried coachman and footman, and will no doubt create quite a stir on the streets of New York. In the construction of these vehicles two general plans have been adopted. In the construction of the surreys and the hansom the design of the body is modified to accommodate the batteries, while in the case of the brougham, delivery wagons, carriages, etc., the entire mechanical and electrical equipment is independent of the body proper, which can be constructed precisely as the present designs.



An Electric Hansom.

Certain essential elements and limiting conditions were clearly demonstrated in the earlier experiments made by Messrs. Morris & Salom, and these were closely followed in the construction of the present vehicles. Briefly, these may be stated as: Maximum total weight of vehicle; maximum total weight of battery; maximum distance and maximum speed.

It has been shown that a variation of any one of these elements will necessitate a change in the others. The best results obtained with these vehicles show that about 1.25 horse-power is necessary for the propulsion of 2000 pounds over ordinary approximately level roads at 10 miles per hour. This consumption of energy, which is only two and a third times that necessary for similar work on rails, is astonishingly small, and can only be obtained by the reduction of all mechanical losses to a minimum, the use of an excellent motor and transmission, and a battery of only sufficient size to afford a practical traveling capacity, thereby bringing the weight within a reasonable limit.

Careful deduction and the result of experiments and trials have enabled the designers to approximately state as follows the limiting figures of the four elements above mentioned:

Max. Total Weight of Vehicle.	Max. Weight of Battery.	Max. Distance. Miles.	Max. Speed.	Av. Speed.
Surreys, 2000 pounds	800	35	15	8
Hansoms, 3000 pounds	1200	25	12	6
Broughams, 3300 pounds	1200	25	12	6
Closed carriages, 3500 pounds	1200	25	10	6
Victorias, 2000 pounds	800	35	15	8
Landaus, 2500 pounds	1200	25	12	6
Delivery wagons, 3000 pounds	1200	25	9	6
'Buses, 5000 pounds				

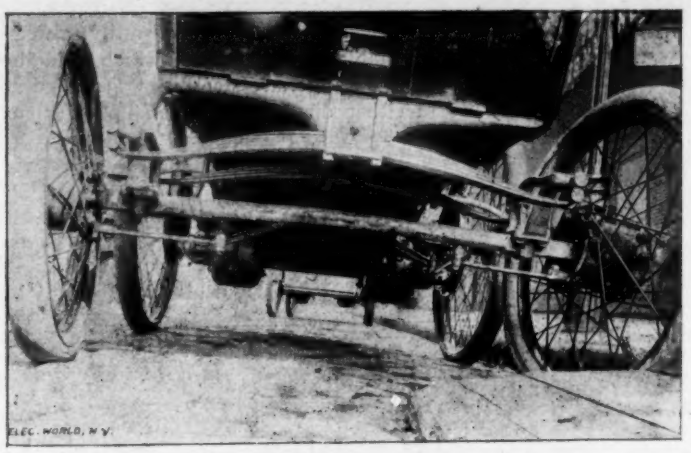
To propel a vehicle weighing about 2000 pounds with passengers, at a speed of 10 miles per hour it would be necessary to have a battery output of somewhat over 1½ horse-power. The essential output would, however, be far exceeded ordinarily and approach nearer 3 horse-power. It has therefore been found that about 9000 pounds of battery are needed to give a traveling capacity of about 30 miles at this rate, or about 1350 pounds with a vehicle weighing complete about 3000 pounds.

It has been urged that the practical electrical vehicle has a very limited traveling capacity. Close investigation will clearly demonstrate the fact that the average carriage or wagon horse does not travel more than 25 to 30 miles per day. It is not expected that a trip from New York to Philadelphia, for instance, should be made with one horse relay; in fact, it would be more in keeping with usual methods to make such a trip by rail. It does not seem essential, therefore, to provide a motor vehicle with any such excessive traveling capacity; but if there should be occasion to do so, the eventual substitution of the electric-motor carriage charging station for the livery stable will make this a possibility.

Greater maximum traveling capacities than above stated are by all means desirable. An electrical vehicle to travel 50 miles could readily be built, but a heavier construction would be necessary throughout in order to accommodate nearly twice the battery capacity. Such a combination would, however, be excessively heavy, at least from a carriage point of view, and limit the safe maximum speed. It would be entirely impracticable to run such a vehicle weighing say 4000 pounds, at a speed of about 15 miles per hour over ordinary streets, aside from the less efficient operation which would result.

Another important consideration and one which has aroused a

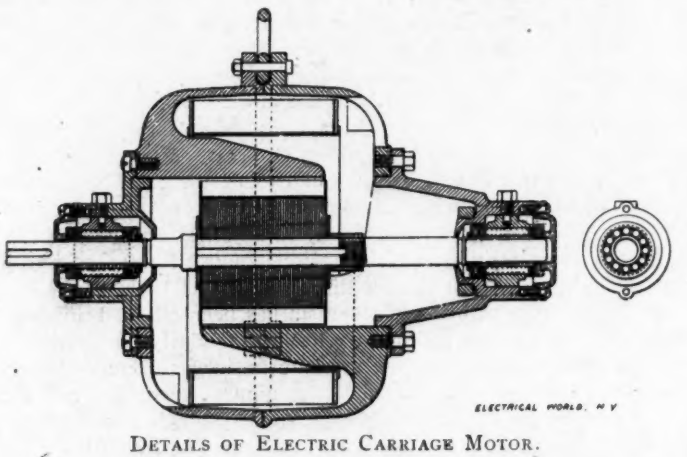
great deal of discussion, is the maximum speed obtainable with such conveyances. A vehicle built for a speed of say 30 miles per hour would probabably have very little utility otherwise than as a racing machine. Electric-motor vehicles, capable of such performance, can readily be constructed, but the necessary reduction of weight in the battery, motor and all other elements would materially affect the stability and satisfactory use of the vehicle. In view of these considerations maximum speeds of about 15 miles for 2000 pounds



DETAILS OF MOTORS AND STEERING GEAR.

vehicles and about 12 miles per hour for heavier vehicles have been adopted in these electric conveyances.

All the various vehicles constructed by this concern are built on very nearly the same general lines. A detailed description of the electric hansoms will therefore serve to illustrate the general features of all designs. In general appearance the electric hansom carries out the lines of this type of vehicle as far as the fore body is concerned. The similarity ends here, however, as the vehicle essentially has four wheels and a rearwardly extending box body carrying the batteries and on which the driver's seat is mounted. In finish the cab body is elegant. The enamelling, trimmings and upholstering are of the finest. The carriage proper is built by the Chas. S. Caffrey Company. Double doors are fitted to the fore body and are operated by means of a lever in front of the driver's seat. An examination of the illustration will show that the vehicle has a very low centre of gravity and that the front and rear wheels are independently fixed to the vehicle body, the front being used for driving and the rear wheels for steering purposes.



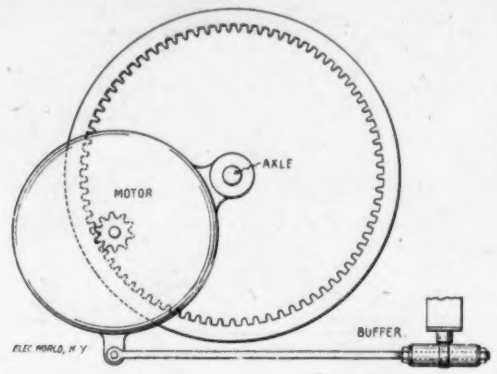
DETAILS OF ELECTRIC CARRIAGE MOTOR.

All the wheels are of a tangent-spoked metallic bicycle-type construction, with heavy 3-inch Hartford pneumatic tires. The latter are inflated to about 100 pounds pressure, giving a flat bearing on the pavement of from 6 to 8 inches. The front driving wheels are 44 inches and the rear wheels 32 inches in diameter. On some of the other vehicles wheels up to 42 inches in diameter and tires 5 inches in diameter are used.

It is to be especially noted that not only have front driving wheels been adopted in these vehicles, but each driving wheel is independently connected to a separate electric motor. It is claimed that several advantages result from the use of rear steering wheels. Unless the weight were properly disposed, however, this arrangement would by no means be desirable. Two-thirds of the hansom and passenger weight is said to be supported on the front wheels. The adoption of two independent driving motors eliminates the use of balance gears, which would be essential otherwise.

THE MOTORS.

In the selection of a motor for these vehicles many elements needed careful consideration in order to secure a motor which should be highly efficient, almost absolutely weather, dust and water proof, and capable of developing for short intervals two to three hundred times its rated normal capacity without developing any defects or weaknesses. A special type of bipolar, single-field coil Lundell motor has been adopted for all these vehicles. These motors have an ironclad, almost

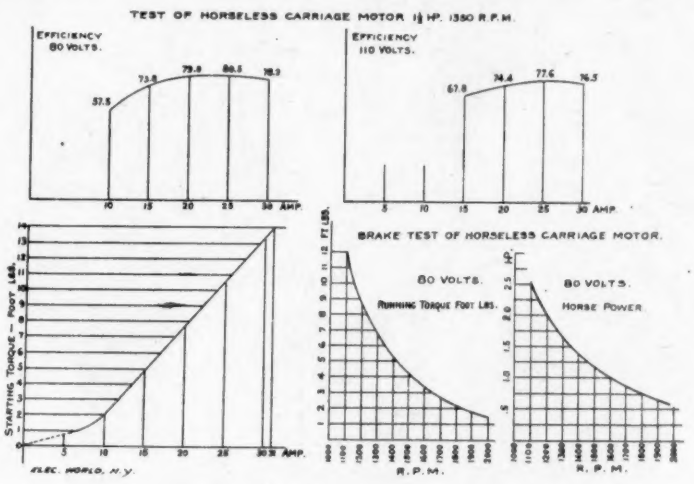


SCHEME OF DRIVING GEAR.

spherical, outer casing, are fitted with self-oiling ball bearings, and are practically dust proof. The hansom motors are each of 1½-hp capacity, weighing 172.5 pounds, and running at a maximum speed of 1350 r. p. m., being series wound for 80 volts. Tests of these motors show some very excellent results, as will be seen from the curves showing current consumption, torque and efficiency.

Two such 1½-hp motors have been found amply sufficient for these hansom cabs, which weigh, complete with passengers, 3000 pounds. Such motors will, without any signs of undue heating or weakness, drive the vehicle at a maximum speed of 15 miles per hour or develop an average vehicle speed of 8 miles per hour for 25 mlies. For larger vehicles, up to 3500 pounds, two 2-hp motors are used. These motors are wound for 75 volts at about 800 r. p. m.

The method of gearing the motors to each drive wheel is very

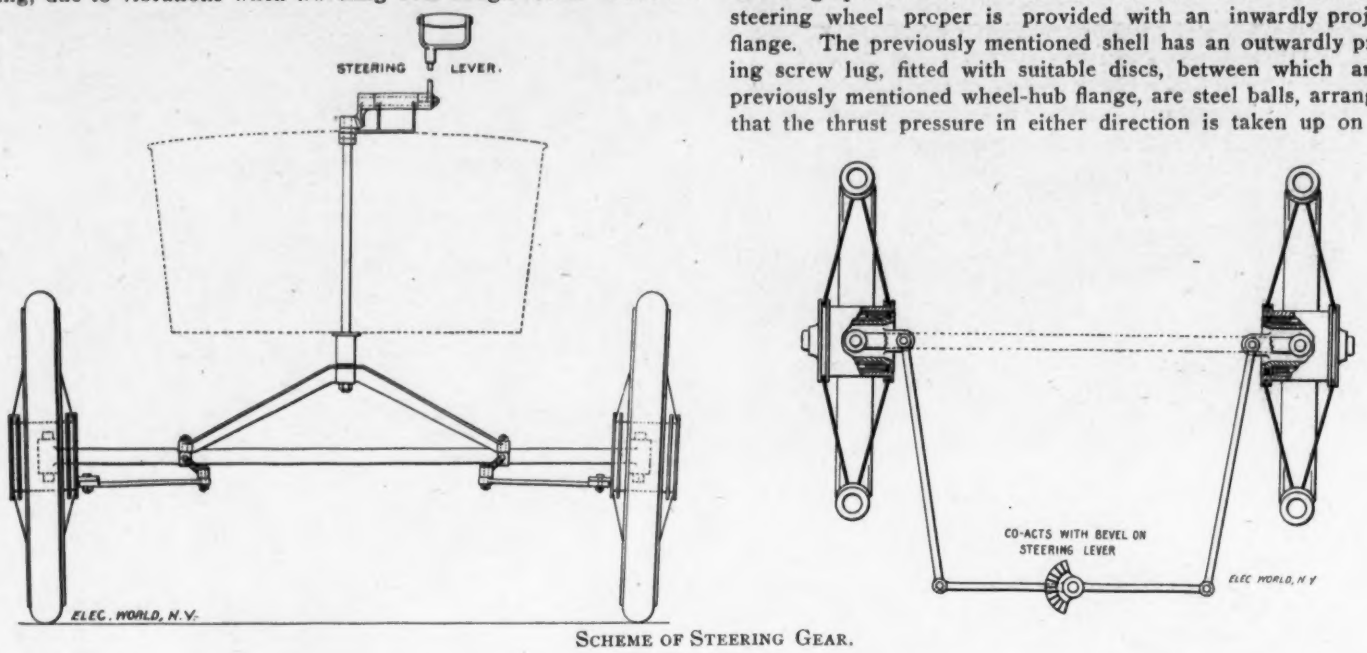


CURVES SHOWING OPERATION OF MOTOR.

simple. The driving wheels rotate on roller bearings at each end of a fixed axle. The gear consists of two internal gears bolted to spun plates of steel, attached to the hubs of the front or driving wheels. The exterior of these internal gears may either form a surface to which the brake is directly applied, or through the medium of a supplemental band furnishing a removable wearing surface, the brake being applied by a foot lever in the usual manner. The pinions on the motor shafts engage directly with the internal gear, thus making a single reduction of suitable proportion between the motors and driving wheels of the simplest possible form.

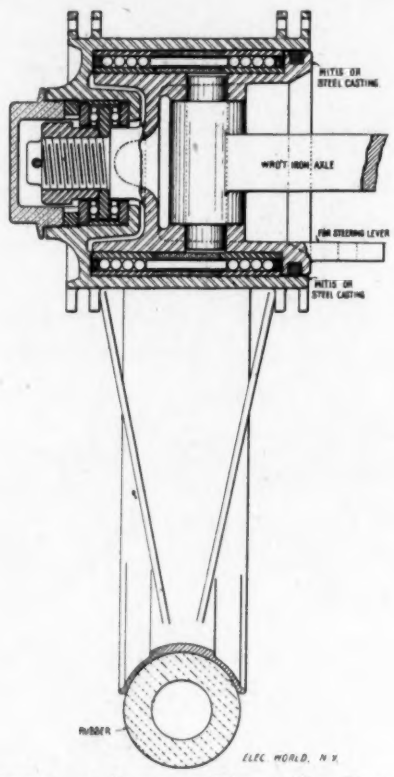
Each of the driving motors is pivotally suspended from the fixed axle supporting the driving wheels. The method of suspension is shown in the illustration. Fixed to the upper part of the

spherical motor arm are two circular clamps holding the motor to the axle, and permitting it to swing radially on the axle, so that the motor pinion always remains in mesh with the gear on the wheel. Attached to the lower edge of the motor frame is a rod, the other end of which is fitted with a rubber buffer, which is fixed to the lower carriage body. This arrangement takes up all slight movements of the motor, and minimizes shocks to the gearing, due to vibrations when traveling over rough roads. Both the driving and steering wheels are, so to say, independent of each other, each set being fitted to a separate supporting gear, on which each end of the carriage body proper is supported.



Scheme of Steering Gear.

The arrangement, which is almost similar in each case, consists of two parallel, slightly bent compound flat springs placed horizontally across the vehicle at a slight distance from each other. These are fastened to suitable bolsters at the bottom of the vehicle body. Connecting the ends of these traverse horizontal springs are short connected springs pivotally attached to each end of the horizontal springs, and centrally fitted to these short connecting springs the fixed axles. Each cab is equipped with a cyclometer, registering the miles traveled.



Detail of Steering Wheel Hub Pivot.

STEERING AND BRAKE GEAR.

A particularly interesting feature of these vehicles is the steering gear, which is what may be called the hub-pivoted type. At each end of the fixed rear axle is a T-shaped double vertical pivot, on which swivels a bearing shell to one side of which is fitted an inwardly projecting arm. An examination of the illustration showing this arrangement in detail, will also indicate the method of taking up side thrusts. It will be noticed that the outside of each steering wheel proper is provided with an inwardly projecting flange. The previously mentioned shell has an outwardly projecting screw lug, fitted with suitable discs, between which and the previously mentioned wheel-hub flange, are steel balls, arranged so that the thrust pressure in either direction is taken up on them. An important feature in this construction is the accessibility to all parts, and the ease with which the entire steering wheel and gear can be inspected.

Attached to the previously mentioned inwardly projecting arm from the pivoted-bearing shell is a pivoted rod connecting each of the steering wheels with opposite ends of a central-pivoted bar under the vehicle body, at about the centre. The pivot of this arm passes up in the form of a post until it reaches the top of the battery-carrying box body, where a bevel-gear segment is fitted to it. This bevel-gear segment meshes with another similar gear attached to the short end of the pivoted steering lever, the other end of which projects upward immediately in front of the driver's seat, and terminates in a spade handle. The movement of this steering handle forward or backward from its normal position operates the gear mechanism correspondingly. The wheels are turned parallel with each other. Although at first sight it might be supposed that steering from the rear would be more difficult than steering from the front, and notwithstanding the consensus of opinion among carriage men was decidedly opposed to rear steering yet as a matter of fact this has not been found to be the case, as the carriages can be moved with the slightest effort on the part of the driver and with the greatest certainty in any direction desired, and be turned completely around in a circle of from 20 to 30 feet in diameter, depending on the length of the wheel base, gauge, etc.

A peculiar form of brake mechanism has been adopted, in which simplicity and positive action have been particularly aimed at. Instead of using a separate brake mechanism, it was decided that the best place for the brake was directly upon the wheel tire. Ordinarily this plan would have been extremely unwise owing to the possibility of serious wear upon the rubber wheel tire. By the use, however, of a peculiar rolling brake shoe the wear has been reduced to a minimum. These brake shoes consist of two concave rubber rollers fitted to opposite ends of a short metallic support bar, which is fitted to one end of a piloted lever, the other end of which is suitably connected with the foot-brake operating lever, immediately on the top of the battery-carrying portion of the body and in front of the driver's seat. One of these brake shoes is arranged to act upon the rear of each driving wheel, as shown in the illustration, and the levers to whicheach is attached come together about centrally between the wheels, where they are connected to the above-mentioned foot-operating device. An application of this brake shoe with almost any pressure possible through the foot-operating device does not cause a rubbing of the wheel tire as would be the case with an ordinary fixed brake shoe.

Street Railway Diagnosis.

SHOWING BY SIMPLE TESTS THEIR INHERITED AND ACQUIRED DISEASES AND SUGGESTING THE REMEDIES.

BY C. BILLBERG.

This paper was written less with the intention to give accurate data concerning any particular plant, than to show how it is possible to reach valuable conclusions regarding any steps it might be advisable to take, from methods similar to those described. Such tests can easily be carried out with such instruments as are to be found in every station.

A street railway in Pennsylvania having recently been investigated by the writer, a brief description and a discussion of a few points might be found interesting.

For various reasons, the name as well as the locality will be omitted, as it does not affect the engineering features at all. It is far from being a typical road, but will probably fairly represent the condition of a large number of plants now in operation.

The oldest part of the road in question was built several years ago, in order to connect a few small villages with a country town. The total length was about 10½ miles, or, referring to the profile map, reached from the point marked *A* to that marked *B*. The power house is located about 5¾ miles from point *A*, or very nearly in the centre of the system at that time. As can be seen from the same map it presents several quite steep grades, the maximum being about 7½ per cent., at a distance of about 4¼ miles from the power house. The general direction of the road is almost in a straight line. It is single track, with turn-outs, and operated at that time six cars on a seven minutes' schedule. A few years later a continuation, almost in a straight line with the older part, was added in order to reach another small town about 4¾ miles distant from the end of the road. This extension necessitated an increase of the station equipment, and with this it is now operated. The present service consists of ten cars with a nine minutes' schedule on the oldest part, or between *A* and *B*, and eighteen minutes on the later addition, or between *B* and*C*.

It can be seen from the profile map that the road is about 78,000 feet, or 14¾ miles long. From *A* to *B* the road follows the valley of a small river, but begins at about *B* to rise over a watershed. The soil consists mostly of gravel and clay.

The power house presents no special features. Its equipment consists of the following:

Four Harrison horizontal return tubular boilers carrying 80 pounds steam pressure. They are 16 feet long by 72 inches in diameter, with about 20 square feet grate surface. Two Frick Corliss engines, cylinders 14 inches in diameter and 36 inches stroke, giving about 85 horse-power at ninety revolutions per minute and one-fifth cut off. They are both belted to a "jack shaft," from which in turn are belted two dynamos. This shaft is provided with a coupling in order to be able to operate each dynamo with either engine or vice versa. This provision has never been used, though both engines and dynamos have been under repair. There are also two Armington & Sims single cylinder, 14½-inch diameter and 15-inch stroke, non-condensing engines, giving at 260 r. p. m. and one-quarter cut off 135 horse-power. To each of these engines are belted two 60-kw dynamos, one from each fly-wheel. The electrical equipment consists of six 60-kw Edison bipolar compound-wound dynamos, giving 525 volts at the bus-bars on the switchboard. The machines are all conected up in parallel on the switchboard, and are provided with compensating bars.

The switchboard, which is simply constructed of wood slats, is equipped with Edison and Thomson-Houston ammeters for the individual machines, and does not present any special features. A Weston illuminated dial instrument, reading up to 2000 amperes, shows total output of current. A small portable voltmeter, Weston standard, is the only potential indicator in the station. Westinghouse automatic circuit breakers protect each feeder from overload.

The station was originally protected from lightning by arresters, but as some trouble from this source was experienced a "tank lightning arrester" was added, with the result that last summer there were but few accidents of this kind, although the road was operated during some very severe storms.

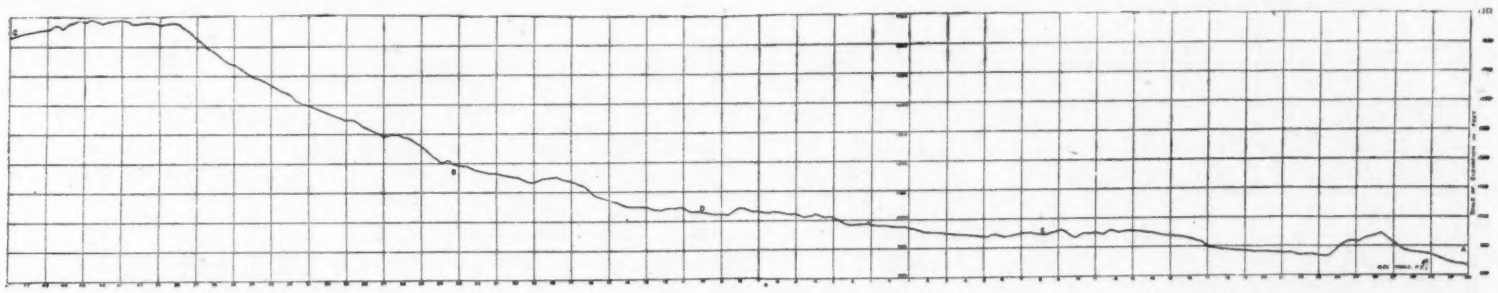
The first car equipment consisted of General Electric 50-wp motors and controllers. At the present 12 and 12A Westinghouse motors and controllers are used. Some General Electric type K controllers are also in service.

Data concerning roadbed, overhead construction and feeders will be given below.

The first test on the road, the result of which will be found in curves *a*, *b* and *c* on the next page, was undertaken with a view to find out what energy a car in regular service would need at the different points of the road, both in regard to current and potential. One of the cars, equipped with Westinghouse No. 12 motors and controllers, and provided with test instruments, was substituted for one of the regular cars and run on schedule time over the line. Its weight, including motorman, conductor, the author and assistants, was 17,500 pounds. This was somewhat smaller than the average, and was so selected in order to be sure not to obtain too large a result. The whole test outfit was exceedingly simple and consisted only of two Weston portable instruments of the small laboratory type. The instruments were in good order and had been recalibrated by the maker just before the test. The voltmeter could measure up to 600 volts and was so connected as to measure the difference of potential between the base of the trolley pole and the ground connection in the controller. The ammeter had a range of 150 amperes and was connected in between the motors and the trolley pole. Previous to this test the accompanying profile map of the road had been made and every fifth pole from the power house to each end had been numbered. The test was conducted in the following manner: A man, stationed on the front platform of the car, called out the number of each pole as sighted by him, and at that instant the instruments as well as the time were read and noted at once.

The result of this test is plotted as curves *a*, *b* and *c* on the map.

By examination of the curve *a* on the above-mentioned map it can be seen that, at one point, on the upper end of the road, the potential dropped to 240 volts and that almost any potential between that and 525 volts at the power house could be found along the line. This large drop of 285 volts, or a little more than 54 per cent., lost in the feeder and return system, necessarily attracts the attention at once. In order to differentiate this loss and so be able to localize its cause, the loss in the overhead system must first be ascertained. This necessitates the making of the following assumptions: First, that each car runs on its specified time and therefore that its position at any moment can be determined by means of the schedule and of curve *a*, and, secondly, that each car consumes the same amount of energy at the same place on the road as the test car did at that place. These assumptions are, of course, not quite correct, but as the energy used by the cars under these assumptions is smaller than in actual practice, the loss accounted for will be too small and therefore the error will affect the result in such a way that it can be safely allowed. Knowing that the cars run on a nine



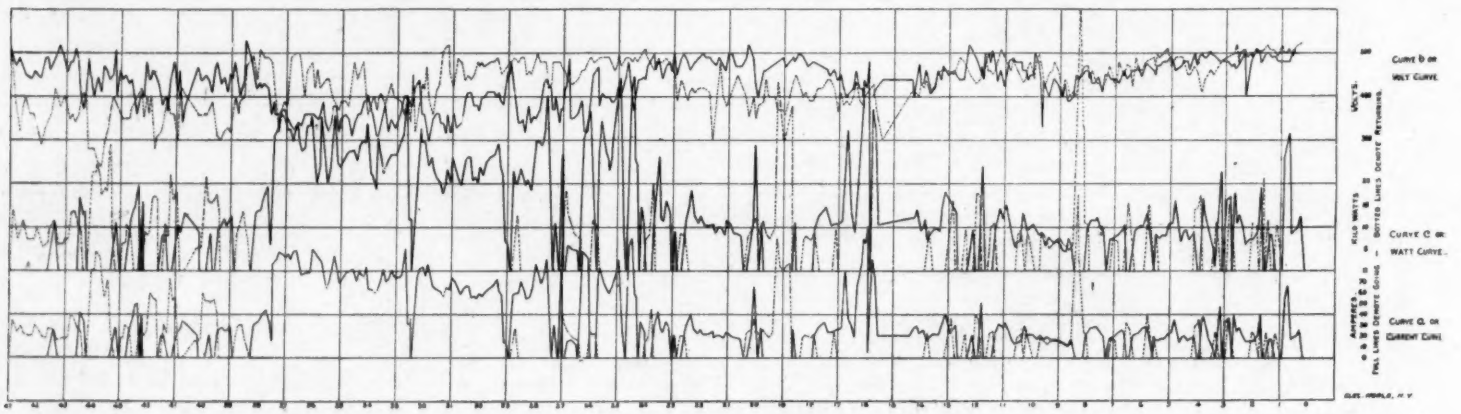
PROFILE MAP.

minutes schedule on the lower part of the road and on an eighteen minutes on the upper part, the cars can be located in their proper places and the correct amount of current allotted to them. Selecting the place where the above-mentioned low potential occurred as the starting point and summing up the different amounts of current used by each car, the output of the station for this end of the road will be found to be 236 amperes at this moment. Taking these various amounts of current in consideration, the total drop of potential in the feeders and in the trolley wires can be calculated and amounts to 133 volts. This figure includes the drop of voltage at the various places where either change of cross-section of feeder or trolley wires or amount of current occurs. If these 133 volts are subtracted from the previous figure of 285, the result, 152 volts, represents the drop of potential in the return circuit, including the drop between the ground connection in the controller and the rails. In view of the fact that the return-circuit is made up of the two rails, a ground-wire, and the ground, including water and gas mains, this figure seems entirely too large.

Before going any further, some facts regarding the roadbed and its construction will be noted. Beginning at the lower end, or at point *A*, the roadway consists of 18,000 feet of 50-pound T rails, 32,000 feet of 40-pound T rails, 4000 feet of 52-pound girder rails, 24,000 feet of 60-pound T rails, laid on cross-ties filled in with dirt. From *A* and *B* to the power house a ground return of No. 0 B & S soft copper wire is provided. Each rail had been connected to this wire by No. 10 B & S. copper wire secured to the rail by a channel pin and to the ground-wire by soldering. This was supplemented later on by a No. 0 long copper bond, riveted in the webs of the rails, and applied throughout the whole length of the road. On the upper end, or between *B* and *C*, the ground-wire was dispensed with.

Before proceeding to calculate the resistance and drop of voltage in the return circuit, some assumptions will have to be made regarding this circuit. In order not to complicate the matter too much, and still to be on the safe side, this circuit will be considered as consisting only of the two rail-strings, leaving out of the calculations the conductivity of the ground, with its network of water and gas-pipes, as well as the ground-wire. It will further be assumed that the resistance of steel is about eight times as high as that of copper. This figure is given in most handbooks as six, but the author considers this too small for the modern high-carbon steel. Under those conditions it can be calculated, precisely as was done when the drop of potential in the overhead system was under consideration, how many volts are lost from car to car, and by adding all these values together the total drop of potential in the rails is found. It should not be forgotten that there are two rails in parallel, and that it must be settled what drop of potential is to be fore the drop of potential from the selected point to the power house can be figured out. Making those calculations and adding together the results, 108 volts is obtained as the total drop of potential in the rails at the time under consideration. Subtracting the above result from 152 volts, which, as found before, represented the voltage lost in the return circuit, there remains yet 44 volts to be accounted for. As this difference is 29 per cent. of the total loss in the return circuit it is evident either that this return circuit is particularly bad, or that some of the above assumptions are wrong. Looking over the latter carefully the errors seem in all cases to be on the right side. In the above calculations the whole current is supposed to return through the rails, an assumption which it is well known cannot be right. In order to find out how much current was returned to the station through the rails and how much by other paths, a rough test was made by taking simultaneous readings of the ammeter giving the total output of current and of another ammeter placed successively in the rail-return circuit and in the other paths to be tested. The result seems to indicate that only about 54 per cent. of the total current leaving the station is returned through the rails and the ground-wire. The rails and the ground-wire were so interconnected that they could not very well be separated. The above percentage thus includes the current returning through the ground-wire to the station. This current was by no means small or negligible, and therefore the above percentage is too large, but it will, however, serve its purpose as it is and will therefore not be changed. By a similar test, it was ascertained that about 42 per cent. of the whole current was returned through a water pipe, and the rest, 2 per cent., according to measurements, or 4 per cent., by accounting for the whole current through the ground proper. This shows that 54 per cent. at most of the current under consideration returns through the rails and it follows that the loss of potential in them is too large in the same proportion. Making a correction in consequence, the loss of potential becomes 58 volts, leaving 94 volts instead of 44 to be accounted for. It was therefore considered as plainly proven that the rail-bonding on the road was in a very bad condition, and that it would be to the interest of the owners to carefully rebond the whole length of it.

As above shown, 42 per cent. of the total output of the station returned through a water pipe. This constitutes a far more important danger to the road than the loss of energy due to a bad return circuit, and it necessitated a further inquiry into the distribution of potential between the rails and the pipes. It might be well to note here that in this particular case the negative bus-bar is connected to the overhead system, the positive one being grounded by means of direct connection to the rails, to the ground-wire, to the ground-plates and to the pipes. As everyone is well acquainted



Voltage, Wattage and Current Curves.

allowed for in each individual joint. The author's own experience in this respect, based on actual measurements, is that with proper rail-bonding the resistance can be reduced to between .000017 and .000034 ohms per joint. It is well to mention that the latter figures were obtained shortly after the joints were made and should therefore be taken as a minimum.* In the present case .004 ohms will be assumed as the resistance of one joint and 30 feet as the length of one rail. Under the above conditions, the resistance and therewith the serious consequences of allowing a large amount of current to flow through a system of either water or gas pipes there is no need of going over the subject here. It may, however, be pointed out that electrolytic action will take place not only where the current leaves the pipes, but also at every joint and, further, that the joint that would be considered the most perfect one from a water or gas engineering standpoint may be the one that will give rise to the worst electrolytic action. In order to ascertain as far as possible the condition of the road in this respect, a series of measurements was taken all along its length, between each fire hydrant or water outlet and the nearest point on the rails, with the following

*The figures were obtained by measuring the drop of potential due to a current of 500 amperes.

results: First, that the rails, from the point marked *C* on the profile map to the neighborhood of the one marked *D* on the same map, are all of negative sign relative to the earth or to the pipe, and that the maximum observed difference of potential was 22 volts on this part of the road.

Second, that the rails, between points marked on the profile map *D* and *E* gave positive signs with reference to the earth and to the pipes, with a maximum difference of potential of 5 volts.

Third, that the rails between points *E* and *A* on the same map gave negative signs with reference to the earth and to the pipes, with an observed maximum difference of potential of 12 volts.

From the indications of the above measurements it can be very clearly seen that the water pipes are subjected to a very strong electrolytic action, and that sooner or later they must give trouble on this account, and as this might involve the road in expensive litigation a plan to obviate this trouble is evidently an immediate necessity. It is quite clear that the larger the resistance, and therefore the drop of potential in the return circuit, the larger is the percentage of current that will return through the pipes, and as the electrolytic action is proportional to the current, it follows that the only thing to do in order to reduce this action as much as possible is to provide a return circuit of such a low resistance that all or nearly all of the current will return to the station through this path. Careful railbonding, though an expensive remedy, appears to be the most economical plan in the end, especially as it will at the same time reduce the excessive loss of energy to a considerable extent.

At the same time it is advisable to change the present connections so that instead of connecting the bus-bars in the station directly with the water or gas pipes, thus inviting the current to go through the very path it ought not to follow, the rail-connected side of the station be kept insulated from the pipes and from the ground, and thereby as much resistance as possible be introduced into this part of the circuit.

The next point for consideration is whether the copper in the overhead system can be further increased to advantage.

This question will have to be answered from an economical point of view, and resolves itself simply into this: How many horse-power hours can be saved per year and what will this represent in dollars and cents? If the reduction in power is so small that the amount of labor in the station will have to be kept the same as before, then, of course, the saving will only be represented by the difference in cost of the amount of coal burned before and after the change, but if the saving is large enough to dispose of some of the labor necessary to operate the station, then the cost of this labor ought to be added to the cost of the coal saved. In the majority of cases the only saving will be the cost of the coal, and therefore the cost of one horse-power per year would be decided by the price of the coal. Taking eighteen hours per day and 4 pounds of coal per horse-power per hour, as a base for the caculations, the result is that about 13.2 tons of coal will be burned per horse-power per year. This will cost at $2 per ton $26.40 per year. Allowing for labor and other factors $40 may be safely assumed to represent the cost of producing 1 horse-power per year in this case.

It might be mentioned here that most of the advice given to the company has been to add more copper to the feeder system. Whether this would be true economy or not will be seen later.

In order to solve this problem data different from those so far given, as to the output of the station in amperes and watts, will be needed. A current curve and a watt curve for a trip have been plotted to this end. After integrating and multiplying by the number of trips per day, the following figures are found, namely, 749,000 watt hours and 1875 ampere hours.

The above numbers represent the average amount of energy and of current used by the cars per day. These figures are the average, pure and simple, but it is advisable to remember that in calculating the losses in the feeder and return circuits, as will be seen later on, these figures must not be used if correct conclusions are to be arrived at. Assuming that the potential at the station is kept at 525 volts, the average output of energy from the station per day would be 985,000 watt hours, showing an average loss of about 23.9 per cent.

As seen above, the amount of copper to be used in any particular case is purely a question of economy and therefore it will have to be decided what percentage of interest and depreciation should be allowed on the invested capital. Ten per cent. will be assumed to cover this, and it will be further assumed that the cost of feeder cables, hung on poles and connected to the trolley wire, will amount to $500 per ton of cables. Under the above assumptions and by making use of Lord Kelvin's well-known law the amount of copper to be used in this case without exceeding the most economical amount can be figured out as follows:

$$a = c\sqrt{\frac{w\ q\ t}{p\ k}}$$

In the above formula the different letters represent the following quantities: a = conductor area; c = current; p = annual rate of interest; q = cost of 1 electrical horse-power per year; t = number of hours per year the current, c, is flowing; k and w are constants. Professor Forbes has prepared some extremely useful tables as a help for solving problems of this kind. They have been published in his Canton lecture for the year 1885 "On Distribution of Electricity."

The assertion is often made that the above formula cannot be used for electric railway problems, as it leads to wrong results. But if it is applied correctly, that is, without disregarding that this c is the "energy" mean current, and not that mean which is arrived at by dividing the total ampere hours per year by the number of hours that the station is at work, because the waste of energy is not proportional to the current, but to the square of the same, the formula is applicable in all cases. Professor Forbes arrived at this "energy-mean" current in the following manner: He considered various values of the current, graded uniformly between its maximum and minimum value, and applied the formula for each step, taking as time the number of hours during which the current was comprised between one step and the next, corresponding to the formula:

$$W = \frac{w}{a}\left[\left(\frac{C}{n}\right)^2 t + \left(\frac{C}{n-1}\right)^2 t_1 + \ldots\ldots C^2 t_n\right]$$

It is evident that the same amount of energy would have been absorbed during the same total time, and in the same circuit, by the passage of a given constant current according to the formula:

$$W = \frac{w\ q}{a} C^2_m\ t$$

In this formula c can be considered as that current which will give the same result as the actual variable current in the station during the year. Its value can be found by elimination of w from the above equations to be:

$$C_m = C\sqrt{\left(\frac{1}{n}\right)^2 t + \left(\frac{1}{n-1}\right)^2 t + \ldots\ldots t_n}$$

As can be seen from the above value of c the smaller n, that is, the number of steps into which the current is subdivided, is made, the easier can the equation be solved, but the less accurate the result. The larger n is made, the more accurate the result, but the more labor is required in order to solve the equation. The author finds c without going through this long and tedious process, in the following manner: Plot a curve with the times as abscissae and the square of the current as ordinates; then integrate the area under the curve, and, after having divided this area by the length of the base line, take the square root of this ratio. This is the value of c, or the "energy-mean" current. The result is far more accurate than that arrived at by the other process, as it takes into account *all* the variations or changes of the current during the period under consideration. Calculations show that in order to reach the most economical point about 49½ tons of copper should be used in this case. By refering to the profile map and making a few calculations it is found that the copper now in place on this end of the road amounts to about 57¾ tons. Therefore the economical amount has already been exceeded. So no more copper should be added except to meet requirements of another nature. It must be borne in mind that changing the schedule would materially change the conditions and modify the above conclusions.

One more problem remains to be considered. At about 44,000 feet distance from the power house the road presents a grade of 7½ per cent., and it happens some times that a car cannot get enough current to climb it if there is at that time a heavy demand for current at other parts of the system.

The inconvenience to the passengers is the smallest objection to such a stalling of a car. Owing to the fact that the line is single

track, it throws the timing of successive cars into a state of confusion which takes some time to overcome. The main objection to such a disturbance is that it demoralizes the force, since it renders it impossible to insist on strict adherence to the schedule and the rules laid down as to the speed on various points of the road. The immediate result is an increase of the repair account due to injudicious but apparently unavoidable use of the controller. The remedies for such a case are not wanting, but it is not so easy to determine which of them is preferable or even acceptable. It would have been easy to so arrange matters at the outset as to entirely avoid the trouble; now all that is left is to choose between the running of a special feeder without a booster, or of a smaller feeder with a booster, the installing of a small storage battery, the raising of the voltage on the whole system, or a few other expedients.

Which one of these should be used is a matter of economy, and that plan is to be preferred which overcomes the difficulty in the cheapest way. Investigating the first proposition and even basing the calculation on such a small feeder as No. 2 B & S, the cost is found to amount to at least $3800. The next point in order is the storage battery question. The smallest battery capacity that would be of any use would have to have an output of at least 20 amperes for the short time that the cars pass this point. Such a battery would cost not less than $2500. This plan would have the advantage that it would tend to equalize the load-diagram of the station, though on account of its small capacity this would not be very much noticed except in comparison with the separate feeder plan. The third proposition to consider is the booster with its feeder, and we find on investigation that this plan will cost about $1500. The next and the last point to consider is the proposition to raise the voltage on the whole station. This would result in reducing the amount of current used per car, and therefore the loss in the return circuit, provided that the speed is not increased. It would also allow the use of the third notch for running the grade in question. The use of this notch for mounting this grade was tried, but although it helped matters somewhat it did not obviate the trouble for the reason that the drop of potential was so large that the remainder could not give enough current or torque to climb the hill. The plan of raising the voltage on the whole station would necessitate a general overhauling of the equipment, as there is danger that otherwise a considerable increase of the repair account would result. It would also require new lamps and possibly some changes in the station, but on the whole it would present valuable features. This plan has the further advantage of requiring but little visible outlay, and therefore will recommend itself to the managers. As said before, the raising of the voltage would result in a proportional decrease in the amount of the average current output from the station and therefore the electrolytic effect on the water and gas pipes would be proportionally decreased, as this action is directly proportional to the current. Several other plans were also proposed, but they all presented some serious objection or objections. For instance, a change in the gearing was considered. The apparent reduction in speed could be allowed in this case, as the schedule leaves ample time between the switches, but firstly the cost, and secondly the well-founded reluctance of every practical railway man to use appliances which are "not standard," dispose of the question. The plan to raise the voltage seems to recommend itself as best, if proper precautions, both in regard to station and car equipment, are observed, and it remains but to briefly discuss the means to effect this rise of potential.

The easiest way would be simply to increase the shunt fields of the dynamos. This would result in changing the characteristic curves of the machines, and they would probably not run so well together on the higher voltage as they did on the lower one. But the main objection is that the rate of compounding (which should be over-compounding) will be lessened, thereby resulting in a comparatively lower voltage at those times when the drop of potential due to the heaviest currents would call for the largest rate of compensation. Therefore this method cannot be used if a considerable increase in voltage is required.

Another way of raising the voltage, without experience with the above enumerated difficulties, consists in increasing the number of revolutions of the dynamos per minute in the ratio of the voltages (the fields being kept constant by introducing resistance in their shunts). This change of speed of the dynamos can usually be effected simply by increasing the speed of the engines. As a rule most engines can stand an increase of speed of at least 10 per cent., and this will correspond to 10 per cent. rise of voltage at the station and considerably more at the cars, as the loss in the feeders will be decreased about 19 per cent., due to the 10 per cent. decrease of current in them. If a higher increase of voltage than this is wanted a change of the pulleys has to be resorted to.

Whichever way is decided upon, the station must be thoroughly overhauled in regard to insulation, both at the machines and at the switchboard. An insulation test ought to be made every day, and a report sent in together with indicator diagrams of the engines and load-diagrams of the output. The car equipment should also be overhauled and afterward subjected to rigid inspection every day. It may seem somewhat disappointing that such an extensive paper does not lead to any definite rules which may be applied off-hand with at least some probability of relieving even obvious evils. In fact, it was written for the purpose of illustrating that each case must be judged on its own merits, and that amounts and specific data are the first step necessary for avoiding hasty conclusions with their sometimes costly consequences. The only general conclusion which the author would lay down is that most electric railways or power plants would be benefited by being subjected to an examination every few years in order to guide the management in its future policy, and facilitate the discovery of points necessary for the economical management of the plant. The tests are exceedingly simple, need to take but little time, and will more than pay for the expense.

The Predetermination of the Regulation of a Transformer with Non-Inductive Load.*

BY F. BEDELL, R. E. CHANDLER AND R. H. SHERWOOD, JR.

In this paper it is proposed to give a method for determining the exact regulation of a transformer without the necessity of applying a load. A corresponding method for obtaining the efficiency of a transformer without loading is in common use;[1] an accurate method for finding the regulation will, it is thought, be of equal service.

An approximate method (which we will call "Method C") for determining the drop in secondary voltage of a loaded transformer without applying a load has already been published[2] and has been employed by one of our largest electrical companies; but the regulation curve determined by this method (see curves C, which follow) are invariably higher than the true curve marked A, obtaining in the usual way by loading the transformer. Curves B are determined by the method to be described in this paper, and are seen to conform much more nearly to the actual regulation curves. The difference is commonly not over one or two tenths of a volt. This requires but two measurements, as will now be described.

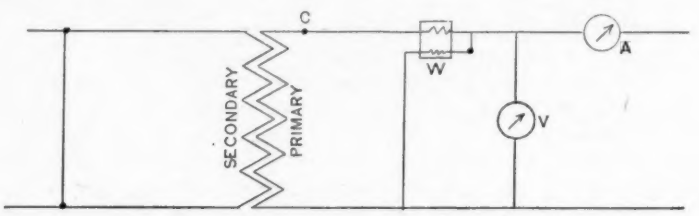


FIG. 1.

For the sake of clearness, a transformer whose ratio is 1 to 1 and whose copper losses in primary and secondary are equal will first

*Presented at the Detroit Meeting of the American Association for the Advancement of Science, Aug., 1897.

1. In this method the transformer is tested by placing a wattmeter in the primary circuit; the secondary (low-potential coil) is short-circuited through an ammeter, and the primary pressure adjusted until the current which flows in the secondary equals the normal full-load current or any desired fraction of it. The wattmeter reading then indicates the copper losses. The secondary is then open-circuited and the normal pressure applied to the primary; the wattmeter reading in this case indicates the core loss. In this way the losses may be obtained and the efficiency calculated. In the open-circuit test, it is often convenient to use the low-potential coil as primary. This method was employed in an extensive series of tests made in 1895 at the University of Wisconsin by Professor Jackson and Mr. Ford. See "A Complete Test of Modern American Transformers of Moderate Capacities," by A. H. Ford; Engineering Series, Bulletin University of Wisconsin, Vol. 2, No. 1.)

2. See Kapp, "Transformers," p. 119.

be assumed. To determine the regulation of a transformer by this method, the secondary is short-circuited by means of a stout copper wire and sufficient voltage applied to the primary to send any particular load-current through the coils. A wattmeter, voltmeter and ammeter are placed in the primary circuit as shown in Fig. 1.[3] The reading of the wattmeter divided by the product of E. M. F. and current will give the power factor; that is, the cosine of the angle Θ of lag between the impressed E. M. F. and the current. In Fig. 2 this angle is represented by N Q F. The line Q N is the voltmeter reading, being the voltage necessary to send the current corresponding to the desired load through the coils. The angle Θ is then laid off. The line N F is drawn perpendicular to Q F and produced to the point M, making N M equal to $\frac{I_0}{I_1} E_1$, where I_1 is the reading of the ammeter, E_1 is the normal primary voltage, and I_0 is the magnetizing current obtained by measuring the primary current when the voltage is normal and the secondary is on open circuit. With M as centre and radius M O equal to the normal primary voltage, draw an arc cutting Q F produced at O. Lay off O L equal to half Q F; draw P L perpendicular to O F and equal to N F. Join P and M, and lay off P S equal to O L. Then S M equals the voltage at the secondary terminals. The difference between S M and O M equals the voltage drop. This is, as before stated, for a transformer whose ratio of transformation is unity.

For a transformer with a ratio of transformation other than unity the construction is exactly the same with the exception that the line S M must be divided by the ratio of transformation to obtain the pressure at the secondary terminals.

In this diagram M F is the total reactive drop and N F that due to magnetic leakage. Q F is the sum of the ohmic drops in the primary and secondary. In transformers of modern design this drop is about evenly distributed between the coils, O L for the primary and P S for the secondary. Q N has been called the impedance drop, being the geometrical sum of the ohmic drop and the reactive drop due to magnetic leakage.

In order to show the facility with which this method may be applied, the following numerical example for the determination of one point on the regulation curve is given. In this instance a commercial transformer was employed with 2500 watts capacity, transforming from 1000 and 100 volts. The primary voltage necessary to send the desired current through the coils with the sec-

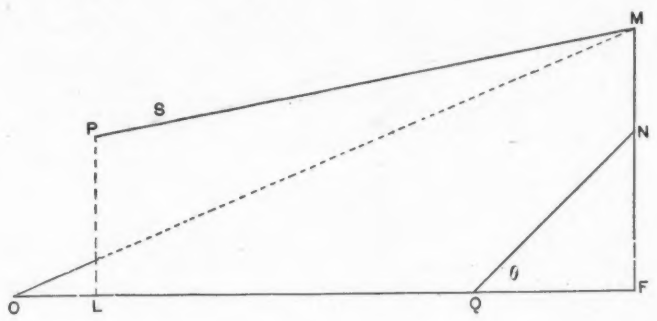


FIG. 2.

ondary short-circuited was 54 volts. The reading of the ammeter was 2.42 amperes, while that of the wattmeter was 72 watts. We have then

$$\cos \Theta = \frac{72}{54 \times 2.42} = 0.554 \; ; \; \Theta = 56^\circ \; 22'.$$

The magnetizing current measured in the usual manner was found to be 0.058 amperes. The right triangle QNF (Fig. 3) is now constructed to convenient scale, the angle N Q F being made equal to 56° 22′, and the hypothenuse Q N equal to 54 volts. We now proceed to calculate the length of the line N M from the formula already given.

$$\text{N M} = E_1 \times \frac{I_0}{I_1} = 1000 + \frac{0.058}{2.42} = 24 \text{ volts.}$$

This line is laid off as shown in the diagram, and with point M as a centre and radius equal to 1000 volts, on the scale selected, an arc is drawn cutting the line Q F produced at O. The length O L is then laid off equal to one-half Q F; and L P drawn equal and

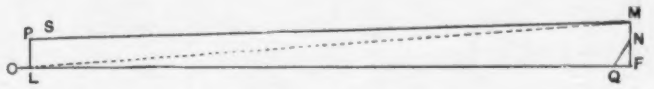


FIG. 3.

parallel to N F. The points P and M are then joined, and a length P S = O L laid off on this line. S M is then the secondary E. M. F. transferred to the primary; this, on being measured, was found to be 968 volts. Dividing 968 by the ratio of transformation, we have the secondary voltage, *i. e.*, 96.8 volts. The actual voltage of the secondary found by measurement was 96.75 volts, showing the great accuracy[4] of the method.

The curves given herewith show the method applied to seven transformers of various types. Transformers number (6) and (7) are small laboratory apparatus having a large amount of magnetic leakage. They are included here to show the applicability of the method to transformers varying widely in their essential characteristics. The remaining curves are taken from well-known commercial transformers of recent types. Curves marked A show the regulation determined by actual measurement, while those marked B are determined by this method. Curves marked C are computed by the method described by Kapp, mention of which has already been made. It will be noticed that curves taken by the proposed new method (B) vary but little from those of actual measurement. In fact the regulation can usually be obtained more accurately by this method than by loading the transformer, the results being less influenced by errors of instruments and fluctuations in the source of supply.

If the readings are taken with accuracy, *one measurement*, with short-circuited secondary, as previously described, together with the magnetizing current, furnishes all the data necessary for the determination of the complete regulation of the transformer. Suppose the diagram in Fig. 3 has been drawn for a load corresponding to a particular current, I'; it is required to determine the drop for any other current, I''. It may be shown (see appendix) that N F and Q F vary directly, while M N varies inversely with the current. Therefore, to determine a new point, it is simply necessary to enlarge or diminish the side of the triangle Q N F by multiplying each side by the ratio $\frac{I''}{I'}$. The line M N is to be multiplied by the inverse ratio, *i. e.*, $\frac{I'}{I''}$. The construction then proceeds exactly as before. The angle N Q F remains unaltered.

The principles upon which this method is based are rational rather than empirical. The more complete theory is discussed in an appendix. What has been given above, however, is sufficient for the practical application of the method. It is pleasing to note the verification of the accuracy of the theory in the actual results obtained are shown by the curves given.

If a wattmeter reading is taken when the magnetizing current is measured, the iron losses are obtained, and the efficiency as well as the regulation determined. A transformer may thus be given a complete test for regulation and efficiency by making two measurements (without loading it), the source of supply being a lamp socket supplied from the house mains. The data for tests on the seven transformers are appended.

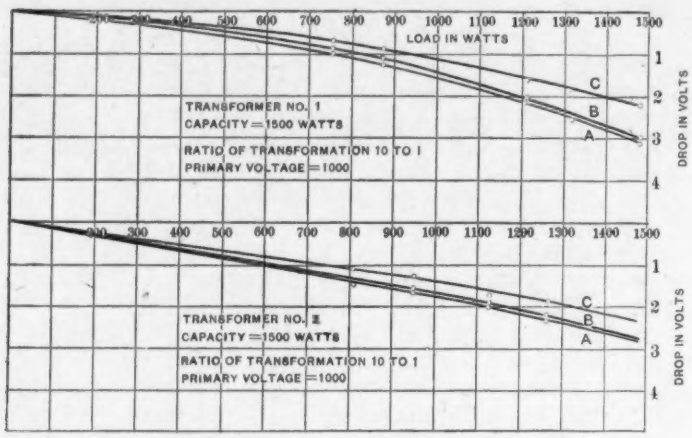
3. After considerable experiment it was found that this manner of connection was most satisfactory. The instruments are all placed in the primary circuit and the secondary short-circuited as directly as possible. Where the voltage is too small to be measured by the ordinary voltmeter, an auxiliary transformer is used to step up the pressure for the voltmeter and voltage-coil of the wattmeter. The reading of these instruments must, of course, be divided by the ratio of transformation of the auxiliary transformer. An approximate correction may be made in this case for the current taken by the auxiliary transformer. This is done by opening the circuit at "C" and measuring the current through the ammeter while the voltage is kept constant. This reading should be subtracted from the former reading of the ammeter to obtain a more accurate value for the current flowing in the transformer being tested.

4. In a long series of measurements, the difference between the observed secondary voltage and the predetermined voltage was rarely as great as 0.2 volts, and was commonly less than 0.1 volt.

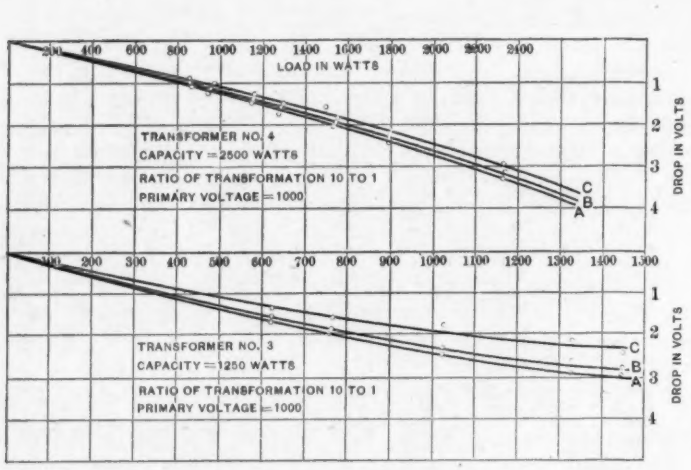
Log of Test No. 1.

Capacity of transformer, 1500 watts.
Ratio of transformation, 10 to 1.
Primary pressure, 1000 volts. Frequency, 126 ~.
Hysteresis loss = 55 watts.
Magnetizing current = .085 amperes.

Primary pressure.	Amperes in primary.	Watts.	Cos θ	Drop method C.	Drop method B.	Actual drop A.	Load in watts.	Efficiency.	K.
35	.755	7.2	.268	.7	1	.85	753	92.5	.0568
35	.76	7							
42	.887	10	.269	1.1	1.1	1.2	877	93.2	.0576
42	.885	10							
51	1.095	14.3	.262	1.34			1010	93.6	.0567
51	1.08	14 1							
61.5	1.32	21.6	.264	1.84	2.2	2.4	1268	94.5	.0577
61.6	1.30	21.6							
64	1.36	23.0	.262	1.85	2.4	2.6	1315	94.5	.0579
64	1.34	23.0							
69.2	1.5	27.5	.265	2.1	2.8	3	1455	94.9	.0562
69.3	1.5	27.5							
70	1.52	28.25	.265	2.2	3	3.1	1483	94.8	.0561
70.2	1.53	28.1							



TRANSFORMER REGULATION CURVES: CURVE A IS OBSERVED; CURVE B, COMPUTED.



TRANSFORMER REGULATION CURVES: CURVE A IS OBSERVED; CURVE B, COMPUTED.

Log of Test No. 2.

Capacity of transformer, 1500 watts.
Ratio of transformation, 10 to 1.
Primary pressure, 1000 volts. Frequency = 126 ~.
Hysteresis loss = 55 watts.
Magnetizing current = .085.

Primary pressure.	Amperes in primary.	Watts.	Cos θ	Drop method C.	Drop method B.	Actual drop A.	Load in watts.	Efficiency.	K.
35	.72	7.25	.288	.99	1.2	1.25	711	92	.059
35	.72	7.25							
40	.825	9.4	.285	1.18	1.4	1.5	812	92.6	.0589
40	.825	9.5							
46.2	.97	12.8	.285	1.3	1.6	1.7	954	93.4	.0577
46.1	.97	13							
55	1.15	18	.285	1.74	2	2	1127	94.2	.0581
55	1.15	18							
61.2	1.3	22.7	.285	1.9	2.25	2.3	1270	94.3	.0575
61.3	1.3	22.6							
76.2	1.61	34.5	.282	2.5	3	3	1562	94.7	.0575
75.8	1.61	34.3							

Log of Test No. 3.

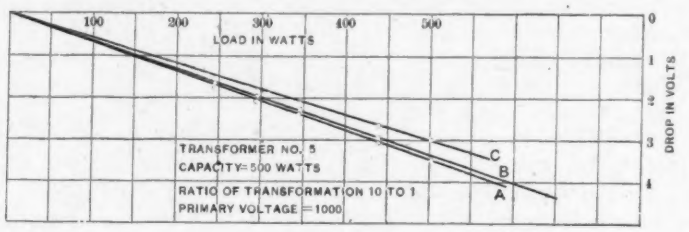
Capacity of transformer, 1250 watts.
Ratio of transformation, 10 to 1.
Primary pressure, 1000 volts. Frequency = 124 ~.
Hysteresis loss = 35 watts.
Magnetizing current = .042.

Primary pressure.	Amperes in primary.	Watts.	Cos θ	Drop method C.	Drop method B.	Actual drop A.	Load in watts.	Efficiency.	K.
15.3	.635	6.5	.667	1.35	1.5	1.6	625	93 8	.0227
15.3	.635	6.5							
19.7	.788	10.7	.675	1.59	1.85	2	773	94.5	.0233
19.5	7.88	10.5							
26.3	1.06	18.6	.670	1.8	2.3	2.45	1033	95.2	.0230
26	1.06	18.5							
32.6	1.36	29.3	.663	2.1	2.6	2.9	1321	95.4	.0226
32.6	1.36	29.4							
36 6	1.49	36.8	.667	2.4	2.8	3	1455	95.5	.0231
36.8	1.5	36.8							
40.9	1 65	45 3	.670	2.7	2.9	3.15	1598	95 2	.0233
41	1.65	45.3							

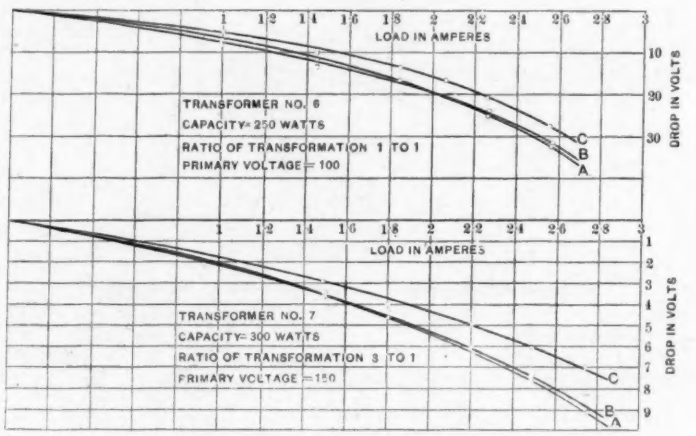
Log of Test No. 4.

Capacity of transformer = 2500 watts.
Ratio of transformation, 10 to 1.
Primary pressure, 1000 volts. Frequency, 126 ~.
Hysteresis loss, 50 watts.
Magnetizing current = .058 amperes.

Primary pressure volts.	Amperes in primary.	Watts.	Cos θ	Drop method C.	Drop method B.	Actual drop A.	Load in watts.	Efficiency.	K.
18	.85	8.25	.545	.99	1	1.1	832	93.5	.022
17.8	.845	8 25							
20.8	.93	10.9	.546	1.05	1.2	1.3	947.5	94.1	.0229
20.7	.96	10.8							
24.05	1.13	14.9	.550	1.30	1.4	1.5	1128	94.5	.0224
24	1.13	14.95							
28	1 32	20 1	.553	1.59	1.65	1.75	1297	94.8	.0224
28	1 32	20.4							
33	1.54	28	.550	1.65	1.9	2	1510	95.2	.0226
32.9	1.54	28.2							
35.25	1.62	32.25	.563	1.92	2	2.1	1585	95.2	.0228
35.25	1.62	32.15							
40.25	1.84	40.5	.550	2.2	2.35	2.4	1795	95.5	.0229
40	1.84	40.5							
54	2.42	72	.554	3	3.2	3.25	2343	95.1	.0226



TRANSFORMER REGULATION CURVES: CURVE A IS OBSERVED; CURVE B, COMPUTED.



TRANSFORMER REGULATION CURVES: CURVE A IS OBSERVED: CURVE B, COMPUTED.

Log of Test No. 5.

Capacity of transformers, 500 watts.
Ratio of transformation, 10 to 1.
Primary pressure, 1000. Frequency = 126 ~.
Hysteresis loss = 28 watts.
Magnetizing current = .037 amperes.

Primary pressure volts.	Amperes in primary.	Watts.	Cos θ.	Drop method C.	Drop method B.	Actual drop.	Load in watts.	Efficiency.	K.
17 3	.25	3 84	.923	1.6	1.7	1.8	245.5	88.5	.096
17	.25	3.8							
20 3	.30	5.67	.93	1.9	2	2.1	294	89.7	.0353
20.3	.30	5 67							
24.9	.355	8 35	.95	2 2	2.35	2.4	346.5	90.5	.0302
25	.355	8.37							
30 7	.452	12.73	.924	2 7	3	3.1	440	91.4	.0356
30 7	.451	12.78							
36	52	17.65	.94	3	3.5	3.5	502	91.6	.0324
35 9	.52	17.64							

LOG OF TEST NO. 6.

Laboratory transformer No. 1. Capacity = 250 watts.
Ratio of transformation, 1 to 1.
Primary pressure, 100 volts. Frequency 126 ~.
Magnetizing current, .381 amperes.

Primary Pressure.	Amperes in Primary.	Watts.	Cos θ.	Drop Method C.	Drop Method B.	Actual Drop A.	K.
21	1	3.01	.143	5	9	8	.0263
21	1	2.99					
32	1.44	6.5	.145	10	14	12.5	.0314
31	1.46	6 5					
41.5	1.83	11	143	14	18	18	.0284
41.8	1.86	11					
46	2.06	14	.146	17	21.75	21.5	.0279
46.5	2.06	14					
51	2.25	16.7	.145	21	24.5	25	.0284
51	2.24	16.8					
57	2.55	21	.143	27.5	32.5	32	
57	2.54	20.8					

LOG OF TEST NO. 7.

Laboratory transformer No. 2. Capacity = 300 watts.
Ratio of transformation, 3 to 1.
Primary pressure, 150 volts. Frequency = 124 ~.
Magnetizing current, .184.

Primary Pressure.	Amperes in Primary.	Watts.	Cos θ.	Drop Method C.	Drop Method B.	Actual Drop A.	K.
12	1.48	3.83	.216	3	3.7	3.6	.01003
12	1.5	3.83	.213				
15	1.81	5.83	.215	4.1	4.5	4.7	.01025
15.2	1.80	5.83	.216				
18.3	2.2	8.67	.212	5	6.5	6.4	.01031
18.3	2.18	8.67	.212				
20.6	2.48	11	.215	6.2	7.5	7.75	.01025
20.8	2.46	11.2	.214				
23.3	2 74	13.93	.218	7	8.4	9.2	.0105
23.3	2 72	13.82	.216				

APPENDIX.

The above method may be rigorously established by employing the transformer diagram, as given in Bedell's "The Principles of the Transformer."

In Fig. 4 let O F be the direction of the primary current in a transformer, and O M the direction and magnitude of the impressed

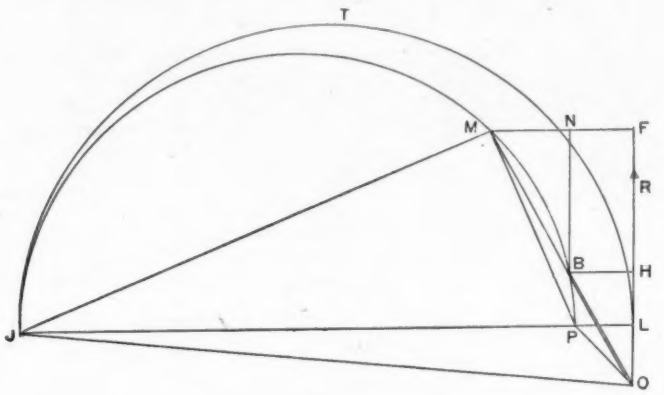


FIG. 4.

electromotive force necessary to send the current O R through the primary coils. As the resistance of the secondary is varied, the electromotive force which would be necessary to maintain this primary current constant would vary along the semicircle J T L, being O J on open circuit, and approaching the point L when the secondary is short-circuited. If, however, magnetic leakage be present, the locus of the primary electromotive force necessary to maintain a certain primary current will be the semicircle J M P. Let O M represent the normal primary electromotive force and O R the normal primary current. O P would be the electromotive force necessary to send the current O R through the transformer, assuming that the secondary is short-circuited and that its resistance is zero. This line will then be the impedance drop caused by magnetic leakage and primary resistance. Then it is evident that P M is the induced secondary electromotive force transferred to the primary*, since when added in its correct vector position to the drop P O it gives the primary electromotive force O M. In order to obtain the electromotive force at the terminals of the secondary it is now only necessary to subtract the drop due to the resistance of the secondary coil. This is to be done algebraically, since the secondary current and electromotive force are in phase for a non-inductive load. If, therefore, a diagram as shown in Fig. 4 can be constructed and the length P M measured, it is only necessary to subtract from this the ohmic drop in the secondary and divide by the ratio of transformation to obtain the electromotive force at the secondary terminals.

In order to construct this diagram proceed as follows: The secondary is short-circuited, and the voltage necessary to drive the current O R through the coils, together with the angle of lag, is measured. This data enables the electromotive force triangle B O H to be constructed. In this triangle the line O H is the ohmic drop due to both primary and secondary, and may be represented by RI where R is the combined resistance of the primary and secondary transferred to the primary; I is the current in the primary coil. B H will be the reactive drop caused by magnetic leakage, and may be represented by $k\,\omega I$ where $\omega = \pi 2$ times the frequency and k equals the self-induction due to leakage. O B is the impedance drop. It will be seen that the sides of the triangle vary directly with the load, and hence the angle Θ is constant for any transformer for given frequency. This will be noted in the tabular data.

In most commercial transformers the ohmic drop is equally divided between the primary and secondary coils. Therefore by bisecting the line O H and making P L = B H, the triangle P O L is obtained. Theoretically P L is not quite equal to B H, but the semicircle J M P is so large that the error is inappreciable. O J would be the electromotive force necessary to drive the current O R through the transformer when the secondary is on open circuit. This line is purely theoretical and may be obtained from the simple proportion

$$O\,J : E_1 :: I_1 : I_0;$$

$$\text{whence} \quad O\,J = \frac{E_1 I_1}{I_0}.$$

Here E_1 is the normal primary voltage, I_1 the normal current, and I_0 the normal magnetizing current. In other words, if a magnetizing current I_0 is produced by an electromotive force E_1, a magnetizing current I_1 would be produced by O J. Sufficient data is now available for the construction of the complete diagram. Since the line O J is very large, compared with the other lines of the diagram, a large scale would be necessary for accurate work. The necessity of constructing the large semicircles may be avoided as follows: From the measurements made, B H or N F may be determined, as already explained. If M N can be calculated the point M becomes fixed, and the essential parts of the diagram may then be constructed.

The triangles P N M and J M P are similar; hence we have

$$J\,P : M\,P :: M\,P : M\,N.$$

$$\text{Therefore,} \quad M\,N = \frac{M\,P^2}{J\,P}.$$

Now, J P may for this purpose be taken equal to J O, since they are both very large as compared with P L or L O, and M P may be assumed equal to the primary voltage. It has been proven by trial that this latter approximation does not affect the result. On substitution of these values the equation becomes

$$M\,N = \frac{E_1^2}{J\,O}.$$

Substituting the value previously obtained for J O,

$$M\,N = \frac{E^2}{\frac{E_1 I_1}{I_0}} = E_1 \frac{I_0}{I_1}.$$

The line M N is the drop due to self and mutual induction. This added to the drop caused by leakage (B H = $k\,\omega\,I$) forms the total reactive drop of the transformer M F.

The point M having been fixed, M O is drawn equal to the primary voltage, and the point O therefore determined. The rest of the diagram is constructed as previously described, and the secondary electromotive force determined.

* That is, the secondary electromotive force multiplied by the ratio of transformation.

His Secret Died with Him.

In the death of Mr. Herbert E. Fowler, which occurred recently at Naugatuck, Conn., the secret of electrically depositing copper upon wood or other rigid or semi-rigid substance is said to have been lost. This process was made possible by coating the substance which was to be plated with copper with a liquid preparation, the secret of which was known only to Mr. Fowler. Every means had been used to induce him to patent the invention, but he declined to do so, fearing that he might lose the value of it in some way. The invention, it is stated, gave so much promise of commercial value.

Alternating-Current Machinery.—XIV.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

IMPEDANCES IN PARALLEL.

123. If *A* and *B*, Fig. 76, are two resistances connected in parallel in a continuous-current circuit, and each resistance is 10 ohms, then their joint resistance will be 5 ohms, or half that of either. If the same pair of parallel resistances are inserted in an alternating-current circuit, their joint resistance will also be 5 ohms, if both resistances are inductanceless. Thus, a bank of ten incandescent lamps, each having a resistance when hot of 100 ohms, will have a joint resistance of 10 ohms, whether they be inserted in a

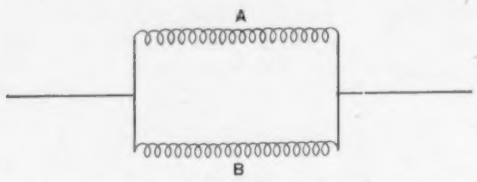


Fig. 76.—Pair of Impedances in Parallel.

continuous-current or an alternating-current circuit. The result is different, however, when the resistances are associated with reactances. In this case, whereas in a continuous-current circuit, the joint resistance of resistances in parallel is always less than the least of the individual resistances, the joint impedance of impedances in parallel may possibly be greater than any of the component impedances. In other words, it is possible to have an impedance of, say, 10 ohms, shunted by another impedance of, say, 10 ohms, and for the two to jointly offer an impedance of, say, 16 ohms.

124. The simplest way of treating parallel resistances in the

Fig. 77.—Impedance and Admittance of Conductor.

continuous-current circuit is to consider their conductances. A resistance of 5 ohms will have a conductance of $1/5 = 0.2$ mho, and a resistance of 0.01 ohm will have a conductance of $\frac{1}{0.01} = 100$ mhos, so that the conductance and resistance of a conductor are numerically reciprocal quantities. The joint conductance of a number of parallel conductances is their sum. Thus, if *A*, Fig. 76, has a resistance of 10 ohms, its conductance, g_1, = 0.1 mho. Also, if *B*

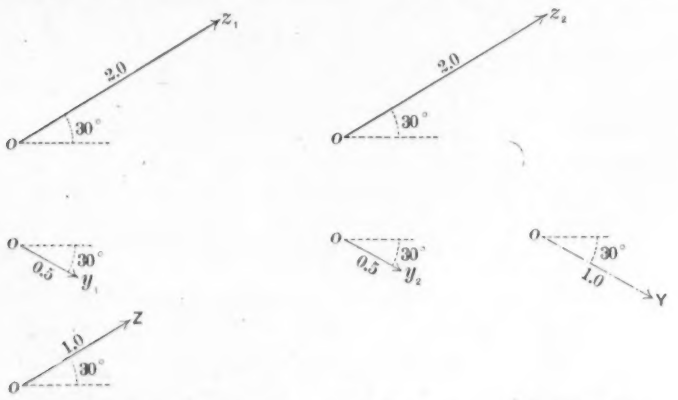


Fig. 78.—Joint Impedance of Two Equiangular Impedances.

has a resistance of 20 ohms, its conductance, g_2, = 0.05 mho. The total conductance will therefore be $g_1 + g_2 = 0.15$ mho, and their joint resistance will be the reciprocal of this, or $\frac{1}{0.15} = 6.667$ ohms. The process may be extended to any number of resistances in parallel.

125. The same rule applies to alternating-current circuits, but since the component impedances are vector quantities, the summation must be effected accordingly. The reciprocal of an impedance is called an *admittance*, expressible in mhos, and is a vector quantity whose magnitude is the reciprocal of the numerical magnitude of the impedance, and whose angle is opposite to the angle of the impedance. Thus, if a coil of insulated wire has an impedance of $2\ \underline{/30^\circ}$ ohms (¶ 94) its admittance will be $\frac{1}{2\ \underline{/30^\circ}} = 0.5\ \underline{/30^\circ}$ mho, as shown in Fig. 77, where $O\,Z$ is the impedance and $O\,y$ the corresponding admittance. When admittances are connected in parallel the total admittance is their vector sum. Thus, if two equal and equiangular admittances, oz_1 oz_2, Fig. 78, each $2\ \underline{/30^\circ}$, be connected in parallel as in Fig. 76, the admittances of each will be $0.5\ \underline{/30^\circ}$

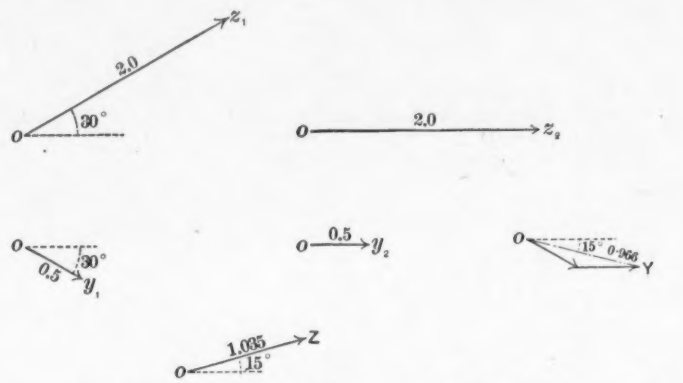


Fig. 79.—Joint Impedance of Two Equiangular Impedances.

mho, as shown at $o\,y_1$, $o\,y_2$, and the total admittance will be $O\,Y = 1.0\ \underline{/30^\circ}$ mho, so that the joint impedance will be the reciprocal of this, or $\frac{1}{1.0\ \underline{/30^\circ}} = 1.0\ \underline{/30^\circ}$ ohm. It is evident from a consideration of this example that whenever the impedances which are connected in parallel are equiangular, their joint impedance will have the same angle, and will follow the ordinary numerical rule of joint resistances in the continuous-current circuit.

126. If, however, one of the impedances is $2\ \underline{/30^\circ}$ ohms, while the other is a reactanceless coil of $2\ \underline{/0^\circ}$ ohms, the admittance of the first will be $0.5\ \underline{/30^\circ}$ mho, and the admittance of the second will be $0.5\ \underline{/10^\circ}$ mho, as shown in Fig. 79. The total admittance will be $0.5\ \underline{/30^\circ} + 0.5\ \underline{/0^\circ} = 0.966\ \underline{/15^\circ}$ mho, while the joint impedance will be the reciprocal of this or $\frac{1}{0.966\ \underline{/15^\circ}} = 1.035\ \underline{/15^\circ}$ ohms. It is, therefore, evident that when the impedances which are connected in parallel have different angles, the angle of their joint impedance

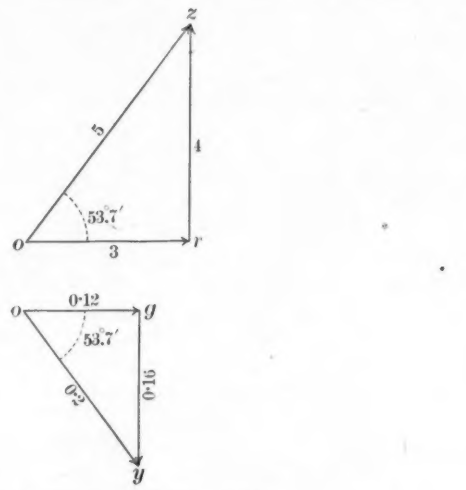


Fig. 80.—Analysis of Admittance.

will generally differ from any of them, and the numerical rule of continuous-current composition is modified vectorially.

The same process applies to any number of impedances connected in parallel. Let the admittances corresponding to the respective impedances Z_1, Z_2, Z_3, .. ohms be Y_1, Y_2, Y_3, ... mhos. Then the vector sum $Y = Y_1 + Y_2 + Y_3 \ldots$ mhos will be the total admittance, and the vector reciprocal of this, or $1/Y = Z$, will be the joint impedance of all the branches.

127. The simplest way of carrying out the process is, perhaps, to resolve the admittances into complex quantities. Thus, if a coil has a resistance of 3 ohms and a reactance of 4 ohms, its impedance $Z = R + j\,X = 3 + j\,4 = 5\,\underline{/53^\circ\,7'}$ ohms, shown at $O\,Z$, Fig. 80. The admittances will be $\frac{1}{5\,/53^\circ\,7'}$, which is shown at $O\,Y$, Fig. 80, to an enlarged scale. But $0.2\,/\overline{53^\circ\,7'} = 0.12 - j\,0.16$. Here the component 0.12 is called the *conductance* of the coil, and the rectangular component $j\,0.16$ is called the *susceptance* of the coil, and is in this case negative, so that just as Impedance = Resistance + j Reactance; or $Z = R + j\,X$ ohms, so Admittance = Conductance + j Susceptance; or $Y = G + j\,B$ mhos. It is necessary to observe that the conductance of a coil is not the reciprocal of its ohmic resistance. Thus, in the case of Fig. 80, the conductance $O\,g$ is 0.12 mho, whereas the reciprocal of the resistance is 0.333 mho. The vector conductance only becomes equal to the conductance of the coil in a continuous-current circuit; *i. e.*, the reciprocal of the ohmic resistance, when there is no reactance and, therefore, no susceptance. Similarly the susceptance of a coil is not numerically the reciprocal of the reactance. The susceptance depends both upon the resistance and the reactance.

If then we resolve a number of admittances Y_1, Y_2, etc., into their components $G_1 + j\,B_1$, $G_2 + j\,B_2$, where G is a conductance and B_2 a susceptance, the total admittance Y will have for its conductance the sum $G = G_1 + G_2 +$ etc., of the separate admittances, and the total susceptance $B = B_1 + B_2 +$ etc., of the separate susceptances.

Thus, if we consider the case represented in Fig. 79, one admittance is $0.5\,\underline{/30^\circ}$ mho, which is readily resolved into $0.433 - j\,0.25$, while the other admittance is $0.5\,\underline{/0^\circ} = 0.5 + j\,0$. Consequently the total admittance is $0.433 + 0.5 + j\,(-0.25 + 0) = 0.933 - j\,0.25 = 0.966\,\underline{/15^\circ}$ mho, making the joint impedance $1.035\,\underline{/15^\circ}$ ohm.

128. Of the six quantities — resistance, reactance, impedance, admittance, conductance, susceptance—only resistance is fixed, and does not vary within the limits of commercially employed frequencies, being the same as in the continuous-current circuit. The five remaining quantities can scarcely be said to have a physical existence, and are only ideal properties, possessed by a conductor when traversed by a sinusoidal current of definite frequency. They are, however, the simplest guides for determining and quantitatively apprehending the behavior of actual alernating-current circuits.

129. In the continuous-current circuit or branch thereof it is a consequence of Ohm's law that the current strength in amperes flowing through the circuit is the product of the E. M. F. in volts, and the conductance in mhos; or, in symbols $i = \epsilon\,g$ amperes.

Similarly, in the alternating-current circuit, or branch thereof, the effective current strength in amperes flowing through the circuit will be the product of the E. M. F. in volts and the admittance in mhos. Thus, if the coil, diagrammatically represented in Fig. 80, be connected across a pair of constant-potential alternating-current mains at 50 volts effective pressure, and whose phase is taken as standard, the effective current which will flow through the coil will be $50 \times 0.2\,/\overline{53^\circ\,7'} = 10\,/\overline{53^\circ\,7'}$ amperes.

Again, the product of the E. M. F. and conductance gives the component of current in phase with the pressure, while the product of the E. M. F. and susceptance gives the component of current at right angles to, or *in quadrature* with, the pressure; or, in symbols,

$$\text{co-directed current} = E\,G$$
$$\text{current in quadrature} = j\,E\,B.$$

Thus, in the case of Fig. 80, with 50 volts applied to the coil, the strength of current in phase with the pressure is $5 \times 0.12 = 6$ amperes; while the strength of current in quadrature with the pressure is $50 \times -j\,0.16 = -j\,8$ amperes.

(To be continued.)

Electric Lighting in Philadelphia.

In the annual report of the Philadelphia Electrical Bureau, a copy of which we have before us, it is pointed out that the cost of electric lights for street lighting in that city is steadily decreasing. The average price per lamp per night in 1895 was 41.15 cents; in 1896 it was 35.5 cents, and in 1897 it will be 33.3 cents. The councils passed a resolution providing for the appointment of a committee to inquire into the subject of an electric-light plant for the city. The result of this, the report says, has not been satisfactory, for nothing whatever has been reported by this committee.

Efficiency of Electric Heaters.

To the Editor of The Electrical World:

It is often stated that the efficiency of the electric heater is 100 per cent., but it will readily be seen that this statement is not strictly correct, and needs to be modified or it will often lead to important errors in calculations. The correctness of the statement depends on what is meant by the rather loose term "efficiency." The efficiency of every dynamo and motor, for instance, would be 100 per cent. if we meant that all the energy delivered to it appears in some form. But such a use of the term would not be of any value, as the efficiency of all converters would be alike. It is this meaning of the term, however, which is referred to when it is stated that the efficiency of electric heaters is 100 per cent. The real and useful meaning of the term is that it represents the relation of the useful output to what may be called the "imput." Every electric heater, even the spark or the arc, heats the material which conducts the curent and this amount of heat is generally a complete loss, just like the starting losses in a dynamo or motor. It is true that this loss is only at the start, but for intermittent heating (which is the very case in which electric heating is more economical when compared with the coal fire), it may be of considerable importance, especially when the mass to be heated is a large one, as in ironing or in some cooking utensils. All this energy is lost until the useful temperature is reached. It is rarely, if ever, the case that all this heat finally becomes useful, as it would mean that the final temperature at the end of the operation must be the same as that before the start; in this case only is the real efficiency 100 per cent., provided there is no useful heat lost by radiation. For continuous heating this loss becomes very small, being relatively smaller the longer the heater continues in action.

Besides this loss there are also the losses by radiation and convexion, which differ from the above in being continuous. These losses depend on the construction of the apparatus and on the temperature. There is also a loss which might be included under convection and which represents that which escapes without heating the final object to be heated, as, for instance, in broilers, etc. On the other hand, there is a slight gain in heat in the arc furnace, due to the combustion of the carbon.

While these questions are, of course, well understood by those who have made a careful study of the subject, it was thought well to call attention to them here as the statement that the efficiency was 100 per cent. is so frequently being made. The losses will often be very small, but they are also frequently quite large.

Yours truly, CARL HERING.

PHILADELPHIA, PA.

Photo-Electric Signal Recorder.

In view of the interest centred at the present time in the very interesting and ingenious device known as the photo-chronograph, developed by Professor Crehore and Lieutenant Squier, and used with such excellent results in the recording of projectile velocities, it is interesting to note the recent apparatus devised by M. Adder, who has communicated a description to the Paris Academy of Sciences. This device consists of a very powerful permanent magnet, in the field of which is placed a small current-carrying wire, through which the signal current is sent. The dynamometer connection between the wire and magnet, the latter of which is fixed, causes a motion in the former, which is recorded photographically. The device is intended to take the place of the siphon recorder, and it is claimed that during a practical test over the Brest-St. Pierre and the Marseilles-Algiers cables the speed of transmission exceeded from 1.5 to 2.7 times that of the ordinary rate practically obtainable by the siphon recorder. It will readily be appreciated that an instrument so arranged will, to a great extent, eliminate the prime objection to devices for similar purposes, namely, the inertia of the moving and recording element, which in this case, it would seem, could be so built that this factor would be almost negligible. If this device fulfills all that is promised for it, the field open to it is unquestionably very large.

Manufacturing Gems.

It is stated to be a very simple matter now to make large gems by fusing a lot of small ones together in the electric furnace. If this is true, gems will lose much of their value. In publishing this we may, perhaps, be exposing the secrets of a very profitable business. Diamonds, we believe, cannot be melted.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Thompson-Ryan Dynamos. M. E. THOMPSON. Lond. *Elec.*, July 30.—A brief communication, suggested by the recent paper of Mordey, describing the commercial progress of these (American) dynamos. It is about two years since the first one was installed in regular service and since that time 75 have been placed in active use, the total capacity being more than 5000 kilowatts; they have been remarkably successful in operation, particularly the larger sizes; a number of 200-kw direct-connected machines are used for street-railway purposes under severe conditions; they are perfectly sparkless, the commutators have not been trued since they were started and the machines are still running with the original carbon brushes; the latter are absolutely fixed in position; some of the data for these generators are given.

Care of Electrical Machinery. BAXTER. *Power*, Aug.—An article of a practical nature showing why brushes must be shifted from the neutral line; it is elementary in character.

Stacking Armature Discs by Machine. RICE. *Amer. Mach.*, Aug. 5.—An illustrated description of a machine which is worked by compressed air.

LIGHTS AND LIGHTING.

Parabolic Reflectors.—Lond. *Elec. Rev.*, July 30.—A note describing the Cowper-Coles process. The moulds are covered with wax, then with a chemical deposit of silver, then with an electrolytic deposit of palladium, and finally with a backing of copper, the mould being kept in motion; it is then either heated to alloy the silver and platinum or the silver is dissolved off. Tests are said to have given most satisfactory results.

Train Lighting. BUETTNER. *Eng. Mag.*, Aug.—He reviews the progress made in lighting cars by electricity and gives information concerning the experience of a number of railways in Europe; in weight, the storage battery has the advantage, as the gross weight of gas tanks for equal lighting efficiency is about 30 per cent. greater; diagrams showing the relative cost per lamp hour for an 8 cp lamp, for electricity and gas, are given; the difference between the two is much less than would be imagined and is slightly in favor of electric lighting for the longer runs, while gas is more economical for short runs. For an average of four hours per day the cost is about the same, being about 0.84 cents per lamp hour.

POWER.

A Power Plant at Massena.—Elec. Rev., Aug. 4, and *Elec. Eng.*, Aug. 5.—A description of the plant to be erected; the former journal contains the longer description and the latter more of the illustrations. This plant, descriptions of which have been referred to before in these columns, is at present under construction and is claimed to be the largest electric and hydraulic power plant in the world; it will consist of 15 units of 5000-hp each; the water from the St. Lawrence River will be led by canal into the neighboring Grasse River; the work is begun and will be completed by the end of next year; a large portion of the power has already been secured by a syndicate for electro-chemical manufacturing purposes, and most of it will therefore be used in the immediate vicinity of the power house; the turbines and dynamos will be direct-coupled and will have horizontal shafts 80 feet long; the three-phase dynamos will weigh about 350,000 pounds each; the diameter of the revolving cast-steel ring will be 15 ft. and the width about 3 ft.; the speed is 180; the magnets revolve and the armature is stationary; the frequency is 60.

Electricity in the Modern Machine Shop. BELL. *Eng. Mag.*, Aug.—A third article of his series. He discusses the new processes based on the use of the electric current; they are discussed only very briefly, some of the applications being accompanied by illustrations; among these processes are electrometallurgy, electric welding and annealing, the use of X-rays, the examination of the solidity of materials, and the electric furnace. The X-rays were applied in a recent case to the rapid examination of nearly a thousand small pieces of apparatus which were ready to ship, but in some of which the interior connections were bad; to have taken them apart would have been very expensive; owing to the X-rays they were all examined quickly and the faulty ones found. These rays can also be used for finding faults and blow holes in castings. He also describes a magnetic method for examining a round steel or iron shaft, for instance; it is surrounded by a coil through which a current is passed, magnetizing the shaft; when a flaw exists or when parts are harder or softer than the rest, the distribution of this magnetism along the bar is changed and this change is readily detected by means of a small movable coil; points of undue strain are also indicated thereby.

Selection of Alternating Current Apparatus for Power Transmission. RAYMOND. *Amer. Elec.*, Aug.—He believes that the ideal way to protect a high-tension plant and over 40 to 50 amperes is to place in the main circuit magnetic circuit breakers capable of carrying and opening safely the necessary starting current; then in series with these, and short circuited by a switch, should be circuit breakers set to carry the maximum safe current for practically non-inductive road; the circuit breaker is preferred to the fuse for all motor work. Direct-coupled generators are recommended, one of the advantages of which is the facility they offer for running in parallel; absolutely exact division of load can be obtained by simply regulating the speeds of the different prime motors, and the differences in the form of the E.M.F. waves do not affect the results; he is running 175-kw motor service and 75 kw in lamps on one triphase circuit with good results; with half the lamps on one of the legs and none at all on the other, the unbalancing effect on the voltage is only 2 per cent.

Care and Oversight of a Power Plant. T. C. SMITH. *Eng. Mag.*, Aug.—He describes the duties of a general manager, the care and management of the attendants and the machinery.

TRACTION.

Exhibit of Traction Appliances.—Lond. *Elec.*, July 30.—An abstract from *Engineering*, describing briefly an exhibit which is said to be one of the most complete at the exhibition, and which embraces a collection of electric traction supplies of all kinds.

Combined Electrical and Mechanical Brake.—Elek. Zeit., July 22.—An illustrated description of the Deri system, in which the first braking action is produced by Foucault currents as long as the speed is sufficiently great, and this is followed by a mechanical braking action when the speed is low, the change being made automatically.

Lausanne.—Lond. *Elec. Rev.*, July 30.—An abstract from the Lond. *Engineer*, giving some data concerning this electric railway in Switzerland, the power for which is generated by two gas engines in connection with accumulators; it requires only two men to operate the power house.

Storage Battery Traction in Chicago. DAMON. *West. Elec.*, August 7.—A long illustrated description of the Englewood and Chicago road, which is now operating with 20 motor cars in the southern part of the city; the ultimate capacity will be 50 cars. One of the chief features seems to be the elevator for removing and replacing the batteries on the cars; the elevator passes up from below the car, the tray of batteries is placed on it, it is then moved sideways and upwards, placing a fresh set of batteries on the cars; the batteries are suspended beneath the cars between the two axles. The 50-hp motor on each truck is said to be suspended on the outside of the car axle in order to leave room for the batteries; the batteries are removed at the end of each trip, the time required for changing a set being 1 1-2 minutes, and requires but one man; there are 72 cells on each car weighing 100 pounds each; they are connected in groups of 18 cells each; the entire weight of the tray of batteries is 7800 pounds; in series they deliver a current of 40 amperes of 144 volts; the round trip is nearly 24 miles and takes about two hours; the cells are fully charged in 40 minutes, although a slightly better efficiency is said to be obtained if the charging time is made longer; the number of batteries is only 50 per cent. greater than the number of cars; for charging there are three dynamos of different voltages, the first one of 160 volts for beginning the charge, the next of 172 and the last one of 176; the controller has five points; on the first the four sets of batteries are in parallel, on the next two in series and two in parallel; on the third they are in series with the resistance, on the fourth without a resistance, and on the fifth with the field of the motor shunted. The power house is then described with the aid of a number of illustrations. No figures regarding the cost of operation are given, but they are promised later.

Fairmount Park R. R., Philadelphia.—St. Ry. Jour., Aug.—An illustrated description of the trolley line in the form of a loop in Fairmount Park, which is one of the largest city parks in the world. The line is 8.5 miles in length; the greatest care was taken to construct the line so as to be inconspicuous and to avoid any injury to the scenery; the roadbed and sides of the track are covered with grass; there are no grade crossings, and many cuts and fills are avoided by following the contour of the

ground; the power station and car house are hidden from sight by mounds of earth; by the use of a mechanical exhaust system a smoke stack is rendered unnecessary; the power station contains a number of interesting engineering features.

Suggestions for Electric Railway Practice. MONROE. *Amer. Elec.*, Aug.—The handling of the controller is discussed in its bearing on efficient working; it is recommended that managers provide a careful method of training and look after the motormen, following a methodical system of inspecting the entire apparatus.

Proper Handling of Controllers. SHORT and DODD. *St. Ry. Jour.*, Aug.—A discussion containing power and speed curves for different rates of acceleration; it is shown that under the conditions given the power consumed is the same after 1500 feet have been traveled, whether a slow or a quick start has been made, and therefore the economy is greater with a quick start.

Electric Railway Motors. HANCHETT. *St. Ry. Jour.*, Aug.—The second of his series of articles; it treats of armature windings.

Trolley Carriage for Common Roads. COLEMAN. *Eng. News*, July 29.—A short article, with an illustration (which however shows nothing but the external view of the carriage), describing the one which is being run experimentally in Greenwich, Conn. The system is for running carriages on the country roads, the power being obtained from two trolley wires on the side of the street on poles; there is no track; the circuit is metallic, as no ground return is possible; a double flexible cable runs from the carriage to the trolley wires, where contact is made by a small apparatus which runs on the wires; experiments have been carried on during the last six months; for those going in one direction the trolley rollers run on the inner wire and for those going in the other direction they run on the outer wire, so that two carriages can pass each other without difficulty. Editorially it is thought that the invention seems to possess little merit, but that it is quite possible that it may be of great practical importance if it could fill the want of cheap transportation radiating from a railway station for a couple of miles.

Electric Railways in Europe.—Jour. Frank. Inst., Aug.—A reprint of the recent table from *L'Ind. Elec.*, containing the general statistics of the electric railways in Europe, the number of which is 150, of which one-third are in Germany.

Extension of Underground Trolley System in New York.—Sc. Amer., July 31.—An illustrated description of the work in progress, involving the rebuilding of over 40 miles of the company's line.

Financial Results of Cable and Electric Railway Operation in the U. S.—St. Ry. Jour., Aug.—The fourth of the series of articles; two street railway systems in manufacturing cities of 60,000 and 90,000 inhabitants are discussed.

Steam Street Cars.—Eng. News., July 29.—A few notes giving data for the cars of the Serpolet system used on the railways of Wurtemberg; these cars are to be used on the ordinary railroad tracks between the regular trains.

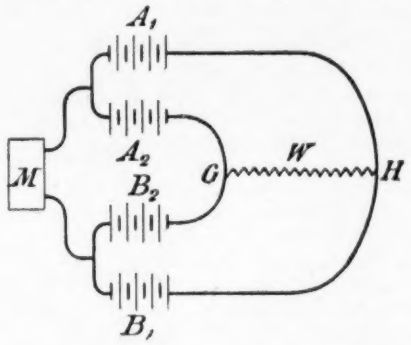
Overhead Construction.—St. Ry. Jour., Aug.—A description with several illustrations, of the recent overhead construction used on the Metropolitan Street Railway Company, of Kansas City.

Hartford.—Elec. Eng., Aug. 5.—A brief illustrated description of the system of the street railway company in that city.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Localizing Faults in Underground Mains. QUIN. Concluded with the discussion in the Lond. *Elec. Eng.* and without the discussion in the Lond. *Elec. Rev.*, July 30; reprinted with the discussion in the Lond. *Elec.*, July 30, where it is also discussed editorially, disagreement being expressed regarding the condemnation of the loop methods.—The discussion of the induction-telephone method is continued; in this method a coil is carried over the surface of the street, a telephone being inserted and an interrupted current being sent to earth through the faulty main; he shows that the effective current in this test is proportional to the stray field; he describes several cases showing the inefficiency of this test; in one case the tester was found tracking the gas main down a side street in which no cables were laid; in another he found a definite hum 200 yards beyond where the fault was. He then describes the compass method, which, with slight modifications, gives surprisingly accurate results; the modification consists in applying the compass method simultaneously to both ends of the faulty main, all other cables in the same trench being disconnected; the compass needle is brought parallel to the main by a bunch of keys or other convenient permanent magnet and the current is applied simultaneously at both ends; the two currents therefore meet at the fault and there pass to earth; the direction of the steady deflection is noted; at the fault the effective current is zero and the deflection reverses on either side; the compass is simply carried along the surface of the street over the main, and where it reverses its direction of reflection it is over the fault; he has used this method very largely and has always found the fault within a yard either way; the disadvantages are that it is applicable only to continuous currents and requires a considerable current to earth, the minimum being about 30 amperes for metal-sheathed conductors 4 feet 6 inches below the surface. He then describes his final method, which is a modification of those just described, and is applicable to alternating currents; two alternating currents of different frequencies are sent into the two ends of the faulty cable and pass to earth at the fault; the currents are generated by induction coils; he prefers 84 and 160 as the two periods, as the two notes produce a "wholesome discord;" he uses a search coil and a telephone, the construction of which is briefly described. The whole apparatus is contained in a small box weighing but seven pounds; it is very sensitive and requires but one ampere; he has also located a break in the pilot wire by measuring the capacities. In conclusion he describes the general nature of faults which may be expected; he prefers the wipe joint for lead-covered cables instead of the glands. The discussion, which was brief, is of no special interest. LACKIE describes a method for the preliminary location of a fault by the use of the ordinary compass; "on a continuous-current system, placing the couples on the main there would be a deflection. Flashing to earth the needle would kick. Only the direction need be noted. Trying along the line in this way, when the fault was passed, the direction of the kick changed."

Rectifying Alternating Currents. GRAETZ. *Elek. Zeit.*, July 22.—An abstract from a recent paper describing an electro-chemical rectifier depending on the principle of polarization of aluminum. It has long been known that an electrolytic cell containing an anode of aluminum offers an enormous apparent resistance to the current, but for the other direction of the current the resistance is scarcely perceptible; it is thought that this is due to a sort of dielectric polarization; such a cell has a definite counter E. M. F. of about 22 volts; currents having a lower voltage do not pass through it at all, while those of a higher voltage are diminished by this amount; a number of such cells in series can therefore be used to generate a counter E. M. F. of any multiple of 22; in the opposite direction the counter E. M. F. is less than one volt; the other electrode does not take an important part and may be made of any convenient material; the liquid must have the property to develop oxygen at the anode, like dilute acids, or more especially solutions of alum. An alternating current sent through a series of such cells will therefore appear as a direct current after the passage; it is pulsating and about half the amount in amperes, but only about half the energy will be required to generate it; by using two series of cells connected in parallel but in opposite directions, as shown in the upper part of the adjoining figure, one will allow only a positive and the other



only a negative current to pass through. This, therefore, forms a rectifier without any movable parts; by duplicating these two rows of cells as shown in the figure, *M* being the alternator, and making the connections as shown, the whole of the alternating current is converted into a direct current through the resistance *W*; it is of course important to have the polarity of the cells as shown in the diagram. The efficiency will depend on the resistance of the cells, which can be made as low as desired; with sufficiently large cells it is claimed that 95 per cent. of the energy will appear in the direct current.

Combined Lighting and Traction Stations. VAN VLOTEN. Lond. *Elec. Rev.*, July 30.—An abstract of the report which was noticed in the *Digest*, July 10.

Windsor.—Lond., *Elec. Eng.*, July 30.—A long, illustrated description of the direct-current accumulator station.

Municipal Ownership.—Amer. Elec., Aug.—The usual methods of opposing the principles of municipal ownership are condemned. Denunciations of the advocates of municipal ownership and arguments based upon legal or ethical ground have little or no weight with the average voter, either through mere indifference, because he considers them *ex parte*, or because he has adopted as a matter of political faith the doctrine attacked, and is therefore not open to reason. The most pernicious line of defense is that in which the motives of those favoring municipal ownership have been indiscriminately pronounced as corrupt and the administration of municipal enterprises pronounced necessarily dishonest; the former, without appreciably affecting public opinion, renders advocates of municipal ownership more rabid, and the latter, particularly in small communities, is apt to be resented as an attack on popular government. It is argued that a privately owned electric plant under proper management should have a margin of profit in its favor over a municipal plant on account of the incentives incident to private enterprise. The argument to be opposed to municipal ownership should be in the form of tabulations show-

ing the actual cost of municipal lighting from present plants, the data to be presented in such shape as to admit of easy verification, authority being given opposite each item for the value quoted; the only comment necessary would be a simple comparative statement of the charge for lighting from privately owned plants in the neighborhood of the town under consideration.

Isolated Plants vs. Central Stations. Moses. *Eng. Mag.*, Aug.—The first part of an article in which he gives the costs of typical installations in five different typical kinds of buildings and compares them with the cost if they obtain the current from the central station; tabular data are given for hotels and apartment houses; the figures are taken from reliable data; he shows that in a number of cases the cost of the plant would be saved in a little more than a year if a private plant is erected instead of taking the current from a central station.

A Modern Small Central-Station Plant. Ray. *Amer. Elec.*, Aug.—An illustrated description of the new Terre Haute (Ind.) central station. The steam is used at a pressure of 200 pounds per square inch; vertical triple-expansion engines, direct-connected arc and two-phase generators, vertical water tube boilers, fuel economizers, mechanical stokers are used; the station sells exhaust steam for heating purposes.

Electric Plant in Tall Buildings. Pattison. *Eng. Mag.*, Aug.—He shows the importance of the elevators, light, heat and ventilation, in the success or failure of a tall building, and gives some hints concerning the selection and care of the machinery; he includes the storage battery in his recommendations.

WIRES, WIRING AND CONDUITS.

Calculation of Wires for Three-Phase Systems. Cahen. *Elek. Zeit.*, July 22.—A reply to the criticism of Szapiro, which was noticed in the *Digest*, July 21.—In the criticism no notice was taken of the fact that the original method was based on an approximation, certain factors being left out of consideration, which he claims is allowable, as their effects are small; Cahen's original deductions were based on the assumption that the voltage of the source was constant and that the current per lamp was constant; while this is not exactly correct, it is sufficiently so for practical purposes; he admits that theoretically his results are not quite correct, but that in practice it is better to make slightly incorrect assumptions, if the errors affect the results too little to be of importance, rather than to make very exact and complicated calculations which give uselessly exact figures.

Regulations.—Lond., *Elec. Rev.*, July 30.—A long editorial criticism of a number of the sections of a recent report of the "Home Office."

Fire Office Regulations Concerning Installations.—Lond. *Elec.* and *Elec. Rev.*, July 30.—A reprint in full of the rules recently agreed upon by the insurance companies concerning electric-power plants.

Magnetic Circuit Breakers.—Cutler. *Amer. Elec.*, Aug.—He considers circuit breakers a step backwards in electrical progress, and maintains that a fuse properly constructed is the most reliable for opening a circuit under any and all conditions; a circuit breaker is usually so constructed that in most cases it is a nuisance, for the reason that it operates frequently when there is no necessity for its doing so, and when it is actually necessary to open the circuit a properly constructed fuse would have answered just as well. A properly constructed fuse should be one so enclosed as to be protected from drafts of air, thereby stopping the dissipation through radiation and convection; the distance between the fuse proper and its terminal blocks should be so great that little heat can be lost through conduction; the main fuse should be made out of a number of small round fuses connected in multiple. The circuit breaker is condemned for use on elevators and the fuse recommended for this work; every circuit breaker should have a time limit, and a properly designed fuse will act quicker than some types of circuit breakers.

Design of a Reliable Fuse. Woodbridge. *Amer. Elec.*, Aug.—The use of alloys to increase the resistance and reduce the fusing point of the fuse is wrong, the effect being to increase the sluggishness of blowing, since the temperature enters into the denominator and the resistance into the numerator of the formula expressing the time limit. Copper fuses are favored for the reason that they make better contacts with their terminals, absorb less power, and do not discolor the porcelain; they are also less affected by temperature changes of atmosphere than fuses with a lower melting point.

New Type of Fuse Cut-Out. Sonneberg. *Amer. Elec.*, Aug.—A fuse cut-out is described and illustrated in which the fuse terminals are at the end of two bars pivoted in the middle of their length; a rubber band or spring is attached to the other ends of the bars, which keep the fuse in tension and when it becomes softened by heat rupture it.

Double End Switch Arrangement. Hobart. *Amer. Elec.*, Aug.—An arrangement of circuits and switches is described by means of which lights may be independently turned on and off at either of two switches.

Interior Wiring.—Amer. Elec., Aug.—The practical details of interior conduit wiring are described.

ELECTRO-PHYSICS AND MAGNETISM

Magnetic Deflection of Cathode Rays. Kaufmann. *Wied. Ann.*, No. 7; p. 544; noticed briefly in the Lond. *Elec.* July 30.—If the lines of force of a uniform magnetic field are at right angles to the rectilinear action of the cathode rays, the latter are deflected so that their path is that of a circular arc whose plane is perpendicular to the direction of the lines of force; the amount depends on the field and on numerous other conditions, such as the exhaustion, the nature of the gas, dimensions of the tube and the presence or absence of spark gaps. He claims to have shown that these are simply secondary conditions and may be reduced to the influence of the discharge potential between the two electrodes; he proves that the deflection is inversely proportional to the square root of the difference of the potentials between the electrodes. It is followed by a note stating that the experiments throw some light on the nature of cathode rays; if true, the charge of each particle must be proportional to its mass, but this is not true if the particles are ions; it is suggested that the returning particles are not taken into account, and that this may make a difference.

Conductivity of Carbon. Callier. *Wied. Ann.*, No. 7, p. 511; abstracted briefly in the Lond. *Elec.*, July 30.—In 1834 Forbes showed that the therma and electrical conductivities of metals had a constant ratio; the present author tested these figures for carbon and found that it should be placed in an altogether exceptionable position; the simple relation observed for the metals seems therefore to be a purely metallical property.

Damping of Rotating Insulators. Duane and Stewart. *Wied. Ann.*, No. 7, p. 436, noticed briefly in the Lond. *Elec.*, July 30.—A description of further experiments supplementary to those of the first author published last year, on the damping of rotating insulators in a magnetic field, showing what he calls a new magnetic effect; the explanation of the effect originally observed, that it was due to the impurities of the iron, was rejected; the present experiments seem to show that the effect is due to the metallic iron.

Terrestrial Magnetism.—Science, July 30.—A brief digest of the articles in *Terrestrial Magnetism* for June. It contains the first full reprint of Fleming's last year's lecture on "The Earth as a Great Magnet." McAdie reviews and summarizes the present state of knowledge regarding the electrification of the atmosphere. Littlehales describes his researches concerning the variations of magnetic inclination. Bower gives formulas for the diurnal range of the magnetic declination and inclination.

Influence of Magnetic Field on Radiation Frequency. Lodge and Davies. *Am. Jour. Sc.*, Aug.—An abstract of the recent paper noticed in the *Digest*, July 3.

ELECTRO-CHEMISTRY AND BATTERIES.

Gold Extraction. Andreoli. Lond. *Elec. Rev.*, July 30.—A continuation of his article (see *Digest*, last week). He criticises very unfavorably the electrolytic system of MacArthur, the process being that of the Cassel Gold Company. The claims of the original specification of James, which appears to consist in the use of lead electrodes in cyanide solutions, and which belongs to the same company, are also given in the same issue.

Relation Between the Capacity and Current in Accumulators. Peukert. *L'Ind. Elec.*, July 25.—A long abstract, with some of the data of the article which was noticed in the *Digest*, June 19.

Gold from Cyanide Solutions. Ehrmann. *Eng. Mag.*, Aug.—A reprint from the *Mining and Scientific Press*, of a recent paper, describing a simplification of the electrolytic process. He holds that the electrolytic processes are better than the zinc processes, as they can be better regulated, but they require more care and skill; he calls attention to the importance of considering the temperature, which is generally neglected; the solution which generally gave the best results was "an ammonia cupric;" he favors the zinc-copper and a hot liquid, as the latter will precipitate as much gold in two hours as could be obtained in twenty-four hours by the cold process.

Thermo-Electric Batteries. Anthony; Reed. *Amer. Elec.*, Aug.—A continuation of the controversy concerning the Jacques cell. Anthony, replying to a criticism, says that in the Jacques cell no substance is reduced and no energy is required for that purpose; the carbon is oxidized and the alkali is changed to carbonate, both operations evolving energy. As to Reed's statement that the introduction of cold air into the Jacques cell is sufficient to maintain the temperature difference, it is replied that he has not shown that the introduction of cold air is necessary, and Anthony predicts that the same action will occur in that cell if the air be heated before it enters a cell to a temperature higher than that of the bath. Reed's statement that the flow of current would transform heat and maintain a difference of temperature is denied, because, if this were true, the difference of temperature produced would be such as to give rise to an opposing E. M. F.; Reed's assumption that the potential difference found when two electrodes of the same metal are maintained at a difference of temperature in an electrolyte is thermo-electric is pronounced purely gratuitous; experiments are quoted which are said to clearly show that the observed potential differences are due to chemical affinities and not to differences of temperature, except as these affinities depend on difference of temperature, the experiments also showing that the oxygen in the Jacques cell is a depolarizing agent performing an office entirely similar to the nitric acid of the Grove element. In reply to Anthony's rejoinder, Reed says that it is difficult to see how the Jacques cell can have its action compared to that of the Daniell, Grove or any other galvanic cell, since in such cells the chemical changes are produced, not by direct action of the active reagents upon each other, but indirectly through

ions furnished by the decomposition of the electrolyte. His contention is that the Jacques cell does not evolve electrical energy by galvanic action; equations of reaction are given showing that as chemical reactions could not take place without the absorption of external heat, the galvanic action could never commence. In criticising Anthony's theory that the E. M. F. produced by a hot and cold piece of iron in contact with an electrolyte is due to difference in the chemical affinity at the different temperatures and not due to absorption of heat, he says it would follow that if the conditions can be maintained without external loss of heat, an inexhaustible source of electrical energy would exist.

Electrical Convexion of Certain Dissolved Substances. PICTOU and LINDEN. *Jour. Chem. Soc.*, May; abstracted in the *Am. Jour. of Sc.*, Aug.—They describe experiments to study the nature of the electrical transmission which takes place by means of certain dissolved substances and found a "remarkable mimicry of ionic dissociation."

An Electric Battery for Firing of Cannon. HOBART. *Amer. Elec.*, Aug.—A cheaply constructed form of primary battery of low internal resistance is described, and instructions given for making a firing fuse to be operated by it.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Ratio Between Electrostatic and Electromagnetic Units. MARGARET MALTBY. *Wied. Ann.*, 7, p. 553; noticed briefly in the Lond. *Elec.*, July 30.—She describes a method of determining this ratio based on an arrangement of the Wheatstone bridge, and obtained the value 3.015; the mean value of the best previous determinations is 3.001, both of course being multiplied by 10 to the tenth power.

Measuring Instruments. RAPS. Lond. *Elec.*, July 30.—An abstract of the paper which was noticed in the *Digest*, May 1; the illustrations are reproduced. Editorially the recording instrument is praised, and the universal testing set is thought to be the most practical instrument of its kind.

Sectorless Wimshurst Machines. KEENAN. *Amer. Elec.*, Aug.—The prevailing ideas that sectors are absolutely necessary on a Wimshurst machine is contested, the statement being made that in point of fact they are a detriment when a large output and long sparks are required. The construction of a 12-plate, 32 inch-diameter sectorless machine is described, such a machine having been in satisfactory use in a hospital; 15-inch sparks may be drawn from it, and it is pronounced excellent for Röntgen ray work.

Weston Voltmeter Resistance Curves.—Amer. Elec., Aug.—A formula is given by means of which a curve may easily be constructed, showing the relation between the various deflections of a Weston voltmeter and the insulation resistance corresponding thereto. It is also shown how, having constructed a standard curve, other curves may be simply derived from it corresponding to other voltmeter resistances.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy; Commercial Considerations.—Lond. *Elec.*, July 30.—An editorial notice examining the Marconi system in a commercial spirit, as a stock company is about to be formed to buy the patent. The general principles were all well known and there can therefore be no master patent; the radiator is Righi's and the receiver is of the Branly-Lodge pattern; a novel combination of well-known parts may be commercially valuable if the particular combination is so much better than all possible ones that it holds the field; it is a patent of the latter kind only which might offer a reasonable chance of success; investors should therefore made sure that the particular devices proposed exceed all others in range, reliability and ease of manipulation. There remains the question of what commercial use is going to be made of wireless telegraphy; it may develop into something the use of which is not so very limited, but this is a matter of speculation.

Signalling Through Cables. PRICE. Lond. *Elec. Rev.*, July 30.—An abstract of the article which was noticed in the *Digest*, July 24, under the heading of "Alternating Currents in Concentric Cables."

Different Voltages from One Lead. PENMAN. *Teleg. Age.*, Aug. 1.—A description, with an example, of the way in which the resistance of a wire should be calculated for obtaining different voltages for telegraphic purposes from a dynamo circuit, the effect of the current branched off from this wire being considered.

Shunt Repeater.—Teleg. Age., Aug. 1.—An illustrated description of the Neilson form, which, owing to the satisfaction it has given, is now being introduced into many of the Western Union Company's offices. The distinguishing characteristic of this repeater is the way in which it prevents the transmitting apparatus on one side from opening and producing false breaks during the time the receiving apparatus on the other side is being demagnetized by the opening of the sender's key.

Disturbances on Telephone Lines.—Amer. Elec., Aug.—The principles of electromagnetic disturbances on telephone lines are developed, and their application to the various cases that arise in practice is shown; directions are given for the transposition of telephone lines under different conditions.

Automatic Telephone Exchange.—Elec. Eng., Aug. 5.—An illustrated description of the Strowger automatic exchange at Augusta, Ga., which is claimed to be the largest automatic exchange in the world.

Dynamo Bell Ringing.—Amer. Elec., Aug.—A device is described whereby bells, fire-alarm signals, watchmen's clocks, etc., may be operated by a dynamo current while the machine is running, and be automatically switched on to a primary battery when the dynamo stops.

MISCELLANEOUS.

Feeling Sound. MCKENDRICK. Lond. *Elec. Eng.*, July 30.—An abstract from a Glasgow philosophical paper. The paper gives a large number of curves of vowels and notes of musical instruments reproduced from the phonograph; the description of the method of reproduction is not very clear. Another method is described in which the phonograph record operates on a current, as sound does in the telephone, and the person receiving the sound places his fingers in beakers containing the electrodes and a salt solution; in this way the notes are felt; it is suggested to use this method for communicating with the deaf.

Electric Cooking. FOX. Lond. *Elec.*, July 30.—A brief communication, in which he states, after discussing the question in general, that he has taken readings in a house where all the cooking was done by gas for three months, and then by electricity for three months; these figures check those given by Martin in his recent (American) paper on the daylight work of central stations.

Electric Light Blindness.—Lond. *Elec. Rev.* and *Elec. Eng.*, July 30.—An abstract from the *Lancet*, giving a report of Hill, of two cases in which excruciating pain in the eyes and temporary loss of sight was developed several hours after the subject had been witnessing the operation of an electric drill, in which holes were bored by means of the arc; there appeared to be no permanent after effects.

Biographical History of Electricity.—Amer. Elec., Aug.—The subject of the present installment of this series is Michael Faraday.

Electrical Catechism.—Amer. Elec., Aug.—The current installment treats of the alternating current booster and choke coils.

Lessons in Practical Electricity.—Amer. Elec., Aug.—The subjects of frequency and of mean and effective currents and E. M. F.s are considered.

Time Meter for Arc Lights.

The Zamel Arc-Light Meter Co., Chicago, Ill., has come to the front with a new device for the purpose of timing the use of arc lights. The device is claimed to be reliable in every way, and will positively start the clock movement whenever the current is turned into the meter and lamps. It will also stop the clock when the current is turned off. Central stations may derive a benefit by the adoption of this meter in various ways, by having the customer turn the light on or off as it is needed, thereby saving the salary of a man to patrol the circuits in order to shut off 10 o'clock or other earlier lights. They are also enabled to place new contracts with customers who would not go on a monthly schedule. The Zamel Company states that this meter or timer has been tested by several companies and found to operate in a perfect reliable manner.

ARC LIGHT METER

American Electrical Apparatus in Japan.

The progressive Japanese are following closely in our footsteps in adopting the most advanced and economical methods in the operation of their rapidly multiplying manufacturing plants, and are now beginning to introduce electric power transmission equipments.

Japan is already, we believe, producing her own locomotives and steel rails, while in the course of but a few months she will be manufacturing the necessary rolling stock for the equipment of her railroads.

The location of Japan's new car works is at Nagoya, and in perfection of equipment this plant is said to be unexcelled by anyone of our own car plant.

The Nagoya Car Works will be the first manufacturing concern, not only in Japan, but in all Asia, to adopt electric power transmission, and the C & C Electric Company, of New York and Garwood, N. J., is to have the honor of supplying the entire electrical equipment for this plant. Naturally this contract is looked upon by the C & C Company as an acknowledgement of the merits and general excellence of its dynamos and motors.

The order for this equipment has just been received by the C & C Company through its branch office in Kobe, Japan, from which office the company is said to be receiving orders regularly.

In this installation a Japanese-made engine is to drive an 80-kw slow speed generator of the C & C Company's latest type, which in turn is to supply current for thirty C & C motors of various types and sizes.

The pattern shop is to be supplied with power through a 10-hp

closed iron-clad type C & C motor, which is especially adapted to this class of work.

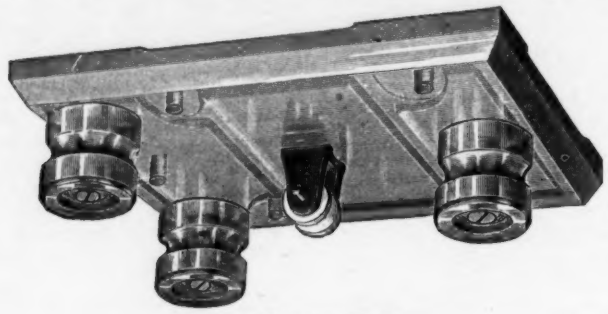
The forges are to be operated by a C & C motor-blower combination of 5-hp capacity, while the machines and tools in their machine shops are to be driven by individual motors of the C & C familiar bipolar curved-field type.

There are to be 28 of these motors. the sizes distributed as follows: Three of 7 1-2 horse-power; five of 5 horse-power, and eight of 1 1-2 horse-power.

In awarding this contract the Nagoya Company, we are informed, gave secondary consideration to the question of price, having determined to buy what seemed to it to be the best apparatus and of unquestioned reputation among American manufacturers. The selection of the C & C Electric Company's machines, therefore, is regarded by that company as a strong endorsement of the merits of its apparatus.

A Glass Hanger Board.

The insulation of appliances used in high-tension series arc lighting is always of the greatest importance, and particularly for inside arc-light wiring, where a dangerous voltage is carried into the building and directly to the lamp. A large number of arc-light hanger boards have been designed from time to time having for their object better insulation, and the Mc-



Glass Hanger Board.

Donald glass hanger board illustrated herewith attains this result in a striking manner. The hanger board consists of glass insulating knobs mounted on a glass base or support. This secures a practically perfect insulation which will always remain constant, as moisture or corrosion is not possible. This hanger makes a bright, clean appearance, and can always be kept in that condition. The extra holes shown in the base allow the board to be used with three insulators, as shown, or with only two insulators, one at each end of the board. When a series of lamps is being hung the board at the end of the series may be used with two insulators, while all the other boards should have three insulators. Thus when the wire reaches the first board it is tied to the first of the two insulators at the double end; from this point a loop is made for the lamp, and the line wire leaves from the other insulator on the double end. This is repeated on each board of the series until the last board, having only two insulators, is reached. On this board the line goes first to the insulator at one end of the board, then through the lamp to the insulator at the other end. From this point it starts back out of the building, using as supports the free insulators on all of the boards having three insulating knobs. This makes a neat arrangement of the loop and at the same time a perfect insulation of both wires. The McDonald glass hanger board is being placed on the market by the Electric Appliance Company, Chicago.

Some New Principles in Dynamo Design.

In the present types of dynamo the field distortion, due to armature reaction, is overcome by the employment either of a large air gap, or oversaturation of the core teeth, or both; the object being to oppose as much reluctance as possible to the M. M. Fs. of the armature, and thus resist or limit field distortion due thereto.

These methods necessitate the employment of large field coils, which impose the necessity of long magnet cores, which in turn require a large and heavy ring or yoke structure.

In spite of the large air-gap reluctance, more or less field distortion takes place, according to the load, thus necessitating a forward shifting of the brushes, which in turn destroys the balance between the front and back armature turns interlinking with the field flux. This proportionately weakens the field magnetism, and imposes the necessity of using series or compounding coils, which still further increase the length of the magnet cores and the amount of magnetizing energy, etc.

All of the above-named conditions therefore conspire to impose the use of a field-magnet structure which is several times heavier than the armature, and which requires a large amount of magnetizing energy, adding enormously to the weight of the machine per unit of output.

To overcome these troublesome and undesirable conditions Mr. A. W. Smith, Washington, D. C., proposes to displace the field-magnet coils rearwardly from the neutral or commutating points, and to wind them in or across the flux paths of their respective magnets, and close to the armature, as shown in the accompanying illustration.

It is obvious that the magnetism generated by any given turn or section of a field coil must pass through turn or section, though it need not necessarily pass through all of the turns or sections of the coil, but may leak out through the side of the coil adjacent to its own turn or section. It follows, therefore, that the magnetism generated by a field coil cannot be shifted forward further than the width of the coil. It is then only necessary to wind the coils entirely back of the neutral lines *a a*, and as close to the armature as practicable, to insure the desired freedom from field distortion. This is made possible by using a field magnet which has on one side of its neutral point a single wide pole, or polar area, and on the other side thereof a plurality of smaller poles forming between them coil-containing spaces (or instead of plural poles a single large coil space), in which space or spaces the coils are wound, as shown.

With this method of winding the field coils, the armature M. M. F. have a long air path, as shown by the endless dotted lines *b b*, thus obviating the necessity for a large air gap reluctance. The size of the air gap is therefore imposed entirely by mechanical conditions, and can be made very small. The core teeth can also have the same reluctance as other parts of the magnetic circuit. The magnets thus requiring only a small fraction of the magnetizing energy now necessary, and the coils being correspondingly smaller, consequently require proportionately less winding space. With this method of winding the field magnet structure has about the same weight as the armature or somewhat less.

Mr. Smith proposes to entirely prevent the spark causing self-induction, represented by arrow *c c*, and due to the rise or increase of current in the armature coils at the moment when their segments leave the brushes, by interlinking the coils at that moment with counter M. M. Fs., as represented by arrows *d d*. These counter M. M. Fs. being equal or superior in strength to those due to the armature coils entirely suppress the latter, thus insuring sparkless commutation. Under these conditions metal or gauze brushes may be used and remain fixed for all variations of load and speed.

With this method the E. M. F. due to self-induction is not neutralized or counteracted by an opposing E. M. F. due to the cutting of a field, but, Mr. Smith claims, is absolutely prevented from coming into existence by the interlinkage of the coil with a field of contrary direction to that which the armature coils tend to set up at the moment the segment leaves the brush. The absence of field distortion and sparking makes it possible to arbitrarily locate the position of the brushes when designing a machine for any given service, thus enabling any kind of automatic regulation to be obtained by simply varying the proportion

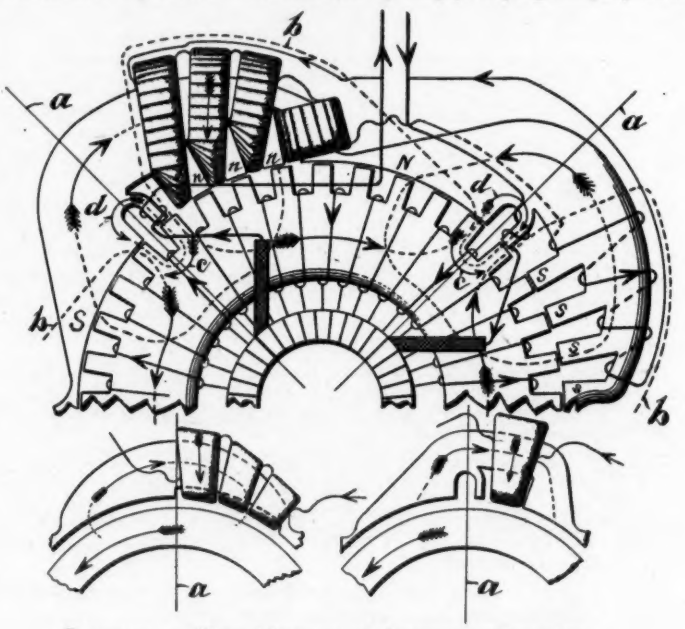


Diagram of New Method of Designing Dynamos.

between the front and back armature turns interlinking with the field flux. With the present types of dynamo the output of the machine is limited by the current-carrying capacity of the armature and by the sparking at the brushes. The carrying capacity, and therefore the output, of most armatures in present use could be greatly increased by a better design of winding, eliminating spiral end connections, etc. This has not been generally done, for the reason that the present low sparking limit would permit of no material increase in output.

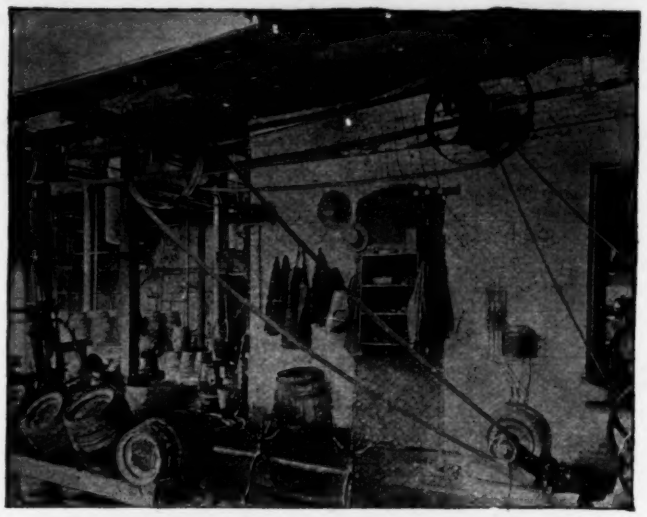
The absence, however, of both field distortion and sparking in the new design herewith makes it possible to take full advantage of all available means for increasing the carrying capacity of the armature, and thus make possible a proportionately greater output from a given size of armature.

The absence of field distortion and sparking also makes it possible to design high-voltage direct-current machines for power transmission over long distances, thus securing higher efficiency, especially at part load, and lower first cost than is possible with the present used methods.

Notable Motor Installations.

The Buffalo Brewing Company, Sacramento, Cal., has recently substituted electric motors for the steam engines upon which it had previously been dependent for power, with gratifying results.

This brewery is one of the largest on the Pacific Coast. Its present motor equipment consists of one 5-hp, one 10-hp and two 30-hp motors. They are all of the General Electric Company's three-phase induction type, without brushes, collector rings or moving contacts, and run almost without attention beyond an occasional oiling. They are driven by 200-volt current supplied from the 1000-volt circuit running from

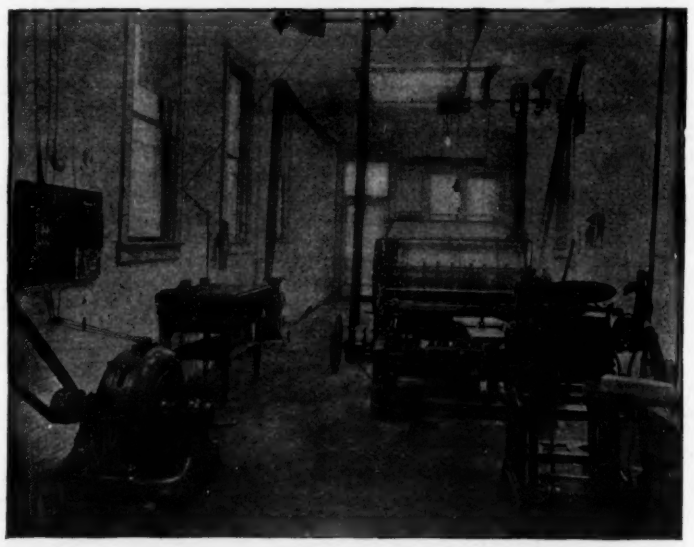


INDUCTION MOTOR IN KEG-WASHING DEPARTMENT.

the sub-station, a distance of two miles, the pressure being transformed down at the brewery.

The smallest motor is used in the bottle-washing house; that of 10 horse-power in the keg-washing department. The three others are used to operate the blowers, the malting house and the machine shops. The large ammonia pumps in the brewery will also shortly be driven by electric motors.

The printing presses of Messrs. Day & Joy, in Sacramento, are also driven by motor. In this case the motor is of similar type to those in the brewery, but of 10-hp. capacity. It was one of the first in the city to take current of the long-distance transmission. On the day of its installation, the 8-hp. engine, formerly used, was draped in crape. Its usefulness had



INDUCTION MOTOR IN PRINTING ESTABLISHMENT.

departed, with its noise, heat and discomfort. The motor now drives one four-roller Huber cylinder press, one Cottrell press and two job presses, and although it has been in use a number of months has not, it is stated, involved the firm in a cent for repairs.

In installing the Buffalo Brewing Company motors the question of the probable economy of the change was naturally uppermost. The guarantee finally given was that electricity would show a saving of 40 per cent. After the motors had been running for some time a series of tests were made, with the result that the saving, instead of 40 per cent., was shown to be actually a little over 50 per cent. Results almost similar have been obtained in other installations in Sacramento.

High-Grade Braiding Machines.

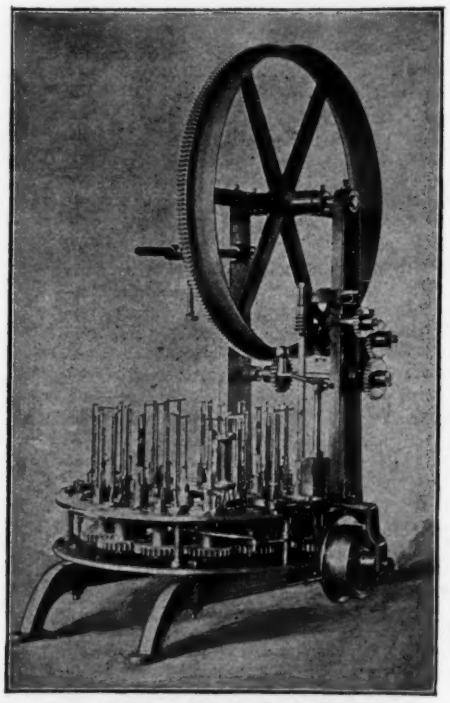
One of the most important machines used in connection with the manufacture of electric wires and cables is the braiding machine, which braids the cotton, jute or silk fibre around the copper wire to form the insulation. Thousands of braiders are running throughout the country and day after day the spools whirl in and out in their zigzag course, twining their threads around the wire as the peasant lads and lasses did the ribbon when they danced around the maypole.

The majority of these machines running to-day are of a construction which presumably suggested itself as the cheapest and most practical at the time, but which, if measured by the standard of excellence which we have become accustomed to expect of American machinery, cannot be considered up to the times. They are made entirely of cast iron and bear the stamp of a foundry product. The plates are cast, the gears are cast with the teeth in, and the carriers are also cast and fitted on the plates as loosely, as is necessitated by this method.

The accompanying illustration represents one of the braiding machines for covering electric wires which are built by Messrs. Thun & Janssen, Reading, Pa., and which are claimed to be strictly high grade, being a machine-shop product. The construction of these machines is as follows:

The top and bottom plates are made of wrought steel. After being made perfectly straight, they are laid out by means of steel templets with the greatest degree of accuracy and the holes for the studs, bolts and small plates are punched in under a very heavy machine. The raceway for the carriers is thus formed in the rough and finished accurately by milling on special milling machines and by hand filing. The carriers are accurately fitted on the plates by means of special machines. The gears are all cut from the solid on gear-cutting machinery. The studs are made from steel and have squares milled on both ends to hold the inner plates firmly in place against the strain exerted by the constant revolving of the carriers.

The advantages resulting from this construction are the following: 1. *Better work*, on account of the steadier movement of the carriers. 2. *More work*, because the machine can be run at a much higher rate of speed on account of the greater accuracy in fitting the carriers. 3. *Saving in power*, because a machine with cut gearing on which carriers and plates are perfectly fitted runs easier. 4. *Saving in space*, the machines being more compact. 5. *No repairs*, because these machines do not get out of



ELECTRIC WIRE-BRAIDING MACHINE.

order. 6. *Longer life* of the machine on account of the superior material and workmanship.

The manufacturers of these braiders have been in business over five years, and during that time have turned out several thousand machines which have already established for the firm a reputation as being among the leaders in this line. The firm has a well-equipped shop full of the latest improved labor-saving machinery and a great many machines to do special parts of the work, which were built by the firm. Messrs. Thun & Janssen build braiding machines only, and by patient and consistent effort aim to do this one thing right.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, August 9, 1897.

ELECTRICAL STOCKS.—There is an evident stronger tone to this market and all quotations that have changed have invariably advanced. The Edison Illuminating stocks are all higher, the New York stock showing a net advance of 1½ points. The Brooklyn stock took a jump and closed with a net gain of 4 points. The rest of the list shows substantial gains.

TELEGRAPH AND TELEPHONE.—With the exception of Western Union no marked changes are noted in this class of stocks. Bell Telephone closed with a net loss of 1½ points, and Erie Telephone 1½. Western Union Telegraph closed stronger, with an advance of 5¼ points, the sales of shares during the week amounting to 73,500.

ELECTRIC TRACTIONS.—A better feeling existed in street railway securities, the renewed demand causing general advances, and more stock changed hands during the past week than for some months past.

	Par.	Bid.	Asked.
ELECTRICAL STOCKS.			
Chicago Edison Company	100	121	..
Edison Electric Ill., New York	100	123½	125¼
Edison Electric Ill., Brooklyn	100	115	116
Edison Electric Ill., Boston	100	147	148
Edison Electric Ill , Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	27⅞	28
Electric Storage, pref	100	31½	32
General Electric	100	87	87¼
General Electric, pref.	100	77	82
Westinghouse Consolidated, com	50	..	22
Westinghouse Consolidated, pref.	50	51	51½
BONDS.			
Edison Electric Ill., New York, con. 5s	105	113½	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	100½
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	237½	239
American District Telegraph	100	..	27
American Telegraph and Cable	100	91½	93
Central and South American Telegraph	100	124	127
Commercial Cables	100	171	..
Erie Telephone	100	64¾	..
New England Telephone	100	104½	105½
Postal Telegraph Cable	100	99	101
Western Union Telegraph	100	91⅛	91¼
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	18⅛	18¾
Brooklyn Rapid Transit	..	33½	33¾
Brooklyn Traction	100	..	14
Brooklyn Traction pref	100	46	48
Buffalo Street Railway	100	70	73
Cleveland Electric Railway	100	..	..
Columbus Street Railway	100	40	42
Hestonville	100	49½	50
Hestonville, pref	..	..	62½
New Orleans Traction	100	6	8
New Orleans Traction, pref	100	28	30
North Shore Traction	100	20	22
North Shore Traction, pref	100	80	82
Rochester Street Railway	..	12	15
Steinway Railway	..	45	50
Union Railway (Huckleberry)	..	95	103
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	93	93½
West End, Boston, pref	100	100¼	..
Worcester Traction	100	15	17
Worcester Traction, pref	100	90	93
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	88½	..
*Buffalo Street Railway 1st con. 5s	100	109	111
Cleveland Electric Railway 1st mtge., 5s	100	102	104
*Columbus Street Railway 1st 5s	100	90	95
Rochester Street Railway 1st 5s	100	..	90
Union Railway (Huckleberry) 1st mtge. 5s	..	106	108
*Westchester Electric 1st mtge. 5s	100	100	103

*With accrued interest

SUMMARY OF ANNUAL REPORT.—The annual report of the Boston Electric Light Company for the year ending June 30 is issued. It shows:

	1897.	1896.
Gross income	$759,643	$660,973
Operating expenses	485,498	420,641
Profits	$274,144	$240,331
Interest charges	63,242	50,319
Net for stock	$218,644	$190,012
Dividends	110,500	136,000
Surplus	$108,144	$54,012

PAYMENT OF DIVIDENDS RESUMED.—The Portland General Electric Company, Portland, Ore., has resumed the paying of dividends on its $1,250,000 of preferred stock. This is the first dividend paid by the electric company since the panic of 1893.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, August 12, 1897.

FOREIGN TRADE IN ELECTRIC MACHINERY.—The steamer "Amana," which sailed from this port a few days ago, carried among her general cargo electrical machinery and supplies to the value of $15,000 or more. This shipment was destined to Cape Town, Africa, and it is stated that large quantities of electrical supplies and apparatus are being shipped to that place.

MR. F. B. DOWNING, vice-president of the Keystone Electric Company, Erie, Pa., was in New York last week calling upon the electrical trade. Mr. Downing reports a decided improvement in the business outlook. The Keystone Company continues to make a specialty of reversible motors for elevators. It has also added new features to its manufactures, and is constantly aiming to improve its product.

WIRE THIEVES.—Detectives are engaged in looking for thieves who cut down 2500 feet of electric wire from the lines of the Mount Morris Electric Company, in Harlem. The wire was cut down some time last Thursday afternoon, while a current of 2500 volts was passing. The officials of the company state the wire must have been cut by an expert lineman or else he would have received the full force of the current, and been instantly killed.

FIRE-ALARM WIRES TO GO UNDERGROUND.—The Fire Commissioners and the Subway Commissioners held a conference at the Mayor's office a few days ago, and discussed the subject of connections by fire-alarm concerns in this city. All the old fire-alarm companies have had their wires placed underground except the Manhattan, and the Fire Commissioners insist that all wires should be buried. Mayor Strong stated that he would see that this request was carried out.

WORK BEGUN ON THE FOURTH AVENUE ELECTRIC ROAD.—The Metropolitan Traction Company has commenced the work of changing its Fourth Avenue line over from horse to electric power. That part of the road along the Bowery was taken hold of first, and the pavement was removed on Tuesday last. Excavation work for the electric conduit will immediately follow, and until the Bowery section is finished the Fourth Avenue cars will not run below Astor Place, where passengers will be transferred to the Broadway line. On the upper end of the line 500 men are at work on the improvements.

THE AFFAIRS OF THE E. S. GREELEY & CO.—A dispatch from New Haven, Conn., on August 4, states that Judge Baldwin, of the Supreme Court, sitting as a judge of the Superior Court, signed an order for a hearing on an application of Mr. Edwin S. Greeley, receiver of The E. S. Greeley & Co., New York, to sell the uncollected claims of the insolvent concern at public auction, and to pay a dividend on the claims allowed against the corporation. A hearing on the application has been set down for August 16. The uncollected bills of the company, it is stated, amount to $15,000. Application has also been made to the United States Circuit Court, of the Southern District of New York, for the removal of the case to the Superior Court of New Haven County. If this is successful, it is expected that the affairs of the company will be wound up in a few weeks. The amount of the dividend which the receiver is prepared to pay has not yet been announced.

MR. FRANK A. ROSS, general manager of the Stromberg-Carlson Telephone Manufacturing Company, Chicago, has been in New York for several days on business. The company is supplying a large and increasing number of telephones for export, and Mr. Ross is arranging to extend this department of the company's business. The Stromberg-Carlson apparatus still continues to maintain the high reputation for which it has long been noted. The company reports not only a steady increase of business in switchboards and telephones for new exchanges and toll lines, but experiencing a large demand for its

"Triplets." The success with which this device is meeting is due to its combining the company's already widely known transmitter and receiver with its gravity switch into one part, so it can be readily attached to any make of magneto, and in this way change the entire talking system of the instrument. It is also used extensively for interior systems in connection with the company's plug switch when battery call is preferred.

BUSINESS IMPROVEMENT.—That we are now once more right in the midst of prosperity cannot be disputed, for the evidences of it are to be seen on every hand, especially among the manufacturers of electrical machinery. Among those conservative concerns who are not to be misled into believing that prosperity has come with every new and unexpected increase of orders, and who inform us that a most decided and steady increase in business is being experienced by them, is the C & C Electric Co., of New York, and Garwood, N. J. The C & C Company stated to a representative of THE ELECTRICAL WORLD a few days ago that it now has more orders on its files, for all types of machines, than it has had at any one time for several years, and is daily increasing its factory force. The demand for its new types of direct-connected and belted multipolar dynamos and of enclosed iron-clad motors during the sixty days in which they have been on the market has already far exceeded the company's highest expectations. The large volume of business which the C & C Company is now doing has made it necessary for it to recall to New York Mr. Campbell Scott, formerly of Louisville, who for the past six or seven months has acted as manager of the C & C Company's Southern office in Atlanta, Ga. Mr. Scott will hereafter make his headquarters at the company's general offices, in New York, and will continue in charge of its Southern business, besides looking after all sales of C & C apparatus in Greater New York. For the present Mr. Scott will also act as advertising manager, and see that his company and its product are kept constantly before the public's notice.

ELECTRICAL WORK FOR THE HARMONIE CLUB.—In connection with the refitting of the Harmonie Club building, on West Forty-second Street, in this city, and in addition thereto of a building for the use of the ladies, there are some electrical features of interest. Three electrical fountains are to be installed of a simple character suitable for indoor use. The fountains will be illuminated by high candle-power incandescent lamps, of which there will be several with different colored globes under each jet. These lamps will be connected to a special commutator which will be driven by a small motor, so that once the motor is started the fountain will run without further attention. The ingenuity of the consulting electrical engineers, Messrs. Osterberg and Sutton, has also been applied to the problem of making a complete stage lighting plant, which shall be readily removable. The theatre is also to be used as a ballroom, and all of the stage and its paraphernalia is designed to be removable in five minutes' time in case an entertainment is to be followed by a dance. The buildings are also to be completely fitted with intercommunicating telephones, no speaking tubes whatever being used. The lighting system is to be most thoroughly carried out, all electroliers being of the Louis XV. style, and many of a specially elaborate design. The building will be ventilated by six forced-draught fans driven by direct-connected electric motors. The wiring of the building will be divided into two main circuits, one carrying the lights and motors most used, the other carrying the stage, ball-room, window-frame lights and other loads only used on special occasions. The idea is to obtain from the current-supplying company a low-meter rate on the first circuit because of its high load factor, and make the second circuit, which is little used, take the high rate imposed on fluctuating loads.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., August 11, 1897.

TWO MORE ELECTRICIANS.—President H. C. Hawks and Treasurer Phillip M. Reynolds, of the Anchor Electric Company, Boston, are the recipients just now of most hearty congratulations. Cause, the arrival of two rousing, handsome "cherubs" of the masculine gender, within one week of each other.

A JOLLY FISHING PARTY.—The New England Electrical Trades Association of Boston enjoyed a most delightful outing last Wednesday, August 4, in the form of a fishing excursion. The little steam tug "Skylark" was especially chartered for the occasion. The weather could not have been better. Everything seemed to combine most happily to assure a royal good time, and it was realized from the start at 9 A. M. to the finish at 6 P. M. The following comprised the party: Frank Ridlon, Gen. Elbert Wheeler, Phillip M. Reynolds, Chas. B. Price, Walter S. Barker, A. Drew, H. H. Brooks, A. T. Clark, T. W. Gleeson, Chas. Garrison, J. W. Poole, F. W. Cramphorn, Sears B. Condit, F. W. Brown and the following as guests: F. M. Kimball, of the General Electric Company, H. M. Ballard, of the West End Street Railway Company; F. W. Platt, of the Ansonia Electrical Company, and R. F. Ross, of THE ELECTRICAL WORLD. The trip around and about Boston Harbor and Massachusetts Bay was, as always, greatly enjoyed; so was the luncheon en route, and particularly caterer Cook's "spread" while at anchor at Marblehead. It goes without saying, however, that the real fun was centred in efforts to tempt and capture some of the finny tribe, which is so abundant in Massachusetts waters. This was the great ambition, and the patience exhibited was simply remarkable. The "finnies," however, seemed to have taken a day off, at least in the vicinity of the "Skylark," much to the discomfiture of the party, particularly of Messrs. Ridlon, Price, Reynolds and Drew; and to the happiness of General Wheeler and others, who were content with the enjoyment of the trip without the fishing sport. The latter did not fail to taunt and exasperate the disappointed ones. Nevertheless, quite a number of fish were landed, and the customary "pot" awarded for the largest fish. Altogether the outing was a success.

INCREASED ITS CAPITAL.—The Ziegler Electric Company, Boston, has recently increased its capital (which now amounts to $40,000), under Massachusetts law, in order to meet its rapidly growing business. This company is now regarded as the foremost of its kind and has earned a deservedly enviable reputation. In the manufacture of electrical apparatus for colleges, schools, laboratory and lecture room, as well as physical and scientific apparatus and general equipments, it has grown enormously. In the manufacture of electrical specialties upon specifications its reputation is so well known as to require no special comment, while in general manufactures, such as burglar alarms, annunciators and smaller specialties it is always kept busy. It has recently taken up the manufacture of X-ray apparatus, and its induction coils, Crookes tubes and fluoroscopes are already in considerable demand because of their excellent qualities. In telephones and telephone work, it has always been an important factor. It also carries in stock a large line of almost everything needed for physical or scientific use, and electrical supplies generally. The Board of Directors of the Ziegler Company is composed of some of the best business men of Boston. Its president, Mr. A. Arthur Ziegler, is an unceasing worker and possessed of just the practical and business knowledge to place this company on its present excellent footing. The company is to be congratulated upon an important acquisition to its official staff, in the person of Mr. Chester Snow, who has been elected its treasurer. Mr. Snow is not new to the electrical business. His father, recently deceased, and who lived to a ripe old age, was one of the pioneers in telegraphy, and it was only natural that his son's experience should be in electrical lines, in which he has been quite conspicuous. Add to this a good business training and general knowledge, and it will be seen that Mr. Snow will be a valuable associate and official of this company.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., August 9, 1897.

NEW ROAD READY FOR BUSINESS.—The Olean, Rock City & Bradford Electric Railway is finished and cars are ready to run. The route is through one of the most picturesque regions of America, one portion being 1500 feet above Olean and 2500 feet above sea level.

THE G. A. R. ILLUMINATIONS.—Preparations for the illumination of the principal streets of Buffalo during the Grand Army encampment are well under way. Though some of the electric current will be generated by local dynamos a point is to be made of the fact that most of it comes direct from Niagara. The effort will in this way be made to convince the many doubters that the current can be successfully transmitted that distance.

ENLARGING A POWER PLANT.—The Niagara Falls Hydraulic Power & Manufacturing Company has closed three important contracts in connection with the enlargement of its electric power plant in the gorge below the flour mills. They are as follows: Structural steel work to the Variety Iron Company, Cleveland; all the valves required, to Messrs. R. Doud & Co., Philadelphia; and the penstock to Messrs. Struthers, Wells & Co., Warren, Pa. This penstock will be 13 feet in diameter and 300 feet long, and will have a capacity of 10,000 horse-power. It is fed from the hydraulic canal that crosses the city, and is part of the plant that furnishes the power to the entire north-side milling district.

PITTSBURG NOTES.

PITTSBURG, Pa., August 9, 1897.

ELECTRIC FOUNTAIN FOR ALLEGHENY PARK.—The electric fountain in Schenley Park has proved to be such a drawing card that a movement is on foot to have the Riverside Park in Allegheny equipped with the same style of attraction. It is reported that the Union Traction Company recognizes that a large amount of traffic would be drawn to its lines by an electric fountain in the park, and has decided to donate a very elaborate one to the city. The sum mentioned as having been set aside for this purpose by the Traction Company is $45,000, the intention being to provide a fountain that will compare favorably with any now in existence.

LARGE CONTRACT FOR ALUMINUM.—The Pittsburg Reduction Company has just closed what is probably the largest contract ever made in this country, if not in the world, for aluminum. The order calls for the delivery of 1000 tons, and was placed with the Pittsburg Reduction Company by an English firm of metal dealers. A portion of the material is to be delivered immediately, but the order is of such a size that it will doubtless keep the works busy for several months in order to complete it, and at the same time supply the demand from other sources. The company is certainly to be congratulated upon securing such a handsome order for export in the face of foreign competition.

ST. LOUIS NOTES.

ST. LOUIS, Mo., August 9, 1897.

THE OLIVE STREET RAILROAD.—At the next meeting of the stockholders of the Missouri Railroad Company the question of converting the Olive Street cable line into an electric road may be discussed. The road is now being equipped with extra long, heavy rails, welded together, and when the deal turning over the road to the Lindell company has been consummated a transfer arrangement will be made.

FRANCHISE GRAB AIRED IN COURT.—The mandamus suit brought by the North & South Railroad Company to compel President E. F. F. Meier of the City Council to affix his signature to the ordinance granting the company a franchise for fifty years came up in the Circuit Court to-day. President Meier refused to sign his name because of irregularity in the passing of the ordinance. The judge took the matter under advisement.

THE EDISON COMPANY TEMPORARILY ENJOINED.—Mr. James Gamble, of New York, one of the small stockholders, has asked for an injunction restraining the Knickerbocker Trust Company, of New York, from foreclosing a $4,000,000 mortgage on the property of the Edison Company of this city. He also asked for an accounting and for the appointment of a receiver for the company. Mr. Gamble sues as a stockholder, owning $5700 stock. He claims that the foreclosure is a "freeze out."

English Notes.

(From Our Own Correspondent.)

London, August 3, 1897.

ELECTRIC TRACTION IN LIVERPOOL.—The Liverpool municipal authorities recently acquired the local tramway system, and a committee was formed for the purpose of considering the most suitable form of traction. It has now been decided to recommend the Council to equip certain sections of the system electrically.

WATERLOO & CITY RAILWAY.—The report of the directors of this concern for the year ended June 30 last states that the directors hope this electric railway will be open for traffic at the end of the present year. One of the two tunnels has been completed throughout and the other is nearly finished, and the generating plant is nearly ready.

METER PATENTS.—Some time ago Messrs. Chamberlain & Hookham, who own the Hookham meter, a very efficient form of motor meter, were successful in an infringement action which they brought against Prof. Perry. On the strength of this action they claim to have a master patent for the motor meter, and, as the British Thomson-Houston Company, who own the well-known meter devised by Prof. Elihu Thomson, have not acknowledged this claim, Messrs. Chamberlain & Hookham are now preparing for a little fray with this well-managed Anglo-American concern.

FIRE OFFICE RULES.—For some time past it has been a general subject of complaint in this country that the various fire offices, instead of agreeing to a common set of rules, prefer to issue separate sets, each differing from the last in some minute and unimportant point. At last the tariff offices have been able to overcome the idiosyncrasies of their respective experts so far as to draw up a uniform set of rules relating to electric power installations. These rules contain nothing striking, and are only noteworthy in so far as they may foreshadow a uniform set of rules relating to ordinary house wiring.

TELEGRAPHIC DISTURBANCES.—The telegraph operators who have been, since the publication of a report of a special committee appointed to investigate their grievances, in an exceedingly disturbed state and threatening to strike, were last week allowed to air their complaints before the Duke of Norfolk, Postmaster-General, and it is generally anticipated that he will be able to assuage their anger. It may be stated that, although such of the grievances of the telegraphists as the public can understand, do not appear to be such as to warrant a mutiny, the hollow fact is that the telegraph section of the Post Office of this country has long been simmering with discontent, because telegraphists are not fairly and, above all, are not sympathetically treated by the Post Office hierarchy, who, although the telegraphs have been under their control for more than a quarter of a century, still affect to regard telegraphists as interlopers and beings quite inferior.

MARCONI TELEGRAPHY.—It was very obvious from the steady flow of puff paragraphs which have been appearing in daily papers ever since Signor Marconi's arrival in this country that he had astute business backers who were determined to run his apparatus and himself for all they are worth. It was, therefore, not surprising to find that last week a company called the Wireless Telegraph & Signal Company, with a capital of £100,000 in £1 shares, was registered at Somerset House, the object of the company being "to acquire from Signor Guglielmo Marconi certain letters patent." Now that Signor Marconi has descended into the commercial arena it may be just as well that the exact commercial value of his apparatus should be put on record. First of all, there can be no suggestion that he owns a master patent, seeing that the general principles underlying his devices are perfectly well known to all electricians. His radiator, he admits himself, is simply a Righi radiator, while his receiver is an obvious though effective variant on the well-known Branly-Lodge coherer. It would seem, therefore, that the only patent which Signor Marconi can take out must be in connection with the use of silver electrodes, a particular mixture (96 per cent. nickel, 4 per cent. silver, trace of mercury) and a particular vacuum (4mm.). Possibly also he may be able to cover the use of an inductive shunt in connection with his tube. Of course, if this particular contrivance is found to be far and away superior to all other devices of the kind this narrow patent may prove commercially valuable, but it still remains to inquire what general industrial utility the Marconi device possesses. In its present embryonic stage of development its sphere of usefulness would seem to be an exceedingly limited one, viz., communication with outlying lighthouses and light-vessels and with fleets. Of course, the Marconi device may develop into something having a much greater range and a much greater reliability than is at present the case, but, meanwhile, sober investors would do well to hold off, though no doubt if they care to become speculators their investments may become exceedingly valuable.

General News.

New Incorporations.

THE ENGLISH ELECTRIC LIGHT COMPANY has been incorporated at English, Ind., with a capital of $5000.

THE MERCHANTS' ELECTRIC LIGHT ASSOCIATION has been organized at Lafayette, Ind., with a capital stock of $30,000.

THE LIVONIA ELECTRIC COMPANY has been organized at Fairport, N. Y., to furnish light and power and electrical appliances. Capital, $1500.

THE BEAVER POWER COMPANY, New Brighton, Pa., has made an application for a charter. The directors are John F. Miner, Jos. F. Mitchell and George D. Douglass.

A CHARTER has been granted to the Greensburg & Mt. Pleasant Street Railway Company, Greensburg, Pa., to build a line from South Greensburg to Mt. Pleasant. Capital stock, $75,000.

CEDAR FALLS ELECTRIC LIGHT, HEAT & POWER COMPANY, Cedar Falls, Ia., has been incorporated to furnish light, heat and power, Capital, $20,000. Directors, Henry Johnson, D. S. Wright and Alfred Grundy.

THE CHILLICOTHE-LAWSON LONG DISTANCE TELEPHONE COMPANY, with a capital stock of $5000, has been incorporated at Lawson, Mo. Incorporators, James S. Girdner, B. P. Gill, Scott J. Miller and others.

THE UNION STORAGE BATTERY COMPANY, with a capital stock of $10,000, has been incorporated at St. Paul, Minn. The incorporators are Frederick C. Phillips, George A. Ford and George N. Sweridge, all of Minneapolis.

THE STERLING TELEPHONE COMPANY, of Sterling, Mo., has been organized with a capital stock of $5000. Directors, Melvin E. Richardson, Herbert K. Lindsey, of Sterling; John Anderson, of Salina; Gustaf A. Anderson, of Lindsburg; Frank A. Lindquist.

THE CITIZENS' ELECTRIC LIGHT AND POWER COMPANY, of Middletown, N. Y., has been incorporated. The incorporators are: J. E. Iseman, Thomas H. Desmond, R. H. Houston, T. E. Hayes, G. G. Otis, F. S. Rogers, H. C. McBriar, T. E. Hayes, R. C. Tuthill, G. H. Iseman, Clarence Abrams and Louis Wolff.

THE SWARTS SWITCHBOARD & ELECTRIC COMPANY has been organized in Knoxville, Tenn. The gentlemen interested are Henry J. Swarts, H. B. Branner, W. H. Gass, W. S. Miller and C. R. McCormick. The company has been organized for the manufacture of telephone supplies, and is arranging to start up at once.

THE NEW LONDON & LOUDONVILLE ELECTRIC RAILROAD COMPANY was organized at Ashland, Ohio, and H. A. Thomas, H. A. Mykrantz, J. R. Swartz, Ashland; G. F. Shelley, Loudonville; S. J. McCready, New London; Bert Hank and E. J. Best, Cleveland, were elected directors. H. A. Thomas is the president, H. A. Mykrantz vice-president, F. N. Patterson secretary and G. A. Ulman treasurer.

THE KANKAKEE, WILMINGTON & MORRIS ELECTRIC STREET RAILWAY COMPANY has been incorporated. The road will run from Kankakee through Wilmington and Braceville to Morris, in Illinois, and the capital stock is $50,000. The incorporators and first directors are: Frank B. Handwerk, Morris; Thomas J. Diven, Chicago; August Dehrich, Kankakee; Cyrus L. Bennitt, Philip I. Cromwell and Julius L. Lins, Wilmington, and J. A. Henry, Joliet.

The Telegraph and Telephone.

RICHMOND, KY.—A telephone line reaching from Berea to Wallaceton has just been completed.

SAN ANGELO, TEX.—The telephone between here and Sonora has been completed. It passes through Eldorado and Christoval.

OSHKOSH, WIS.—An independent telephone line has just been completed connecting the Wausau, Merrill and Tomahawk exchanges.

LOUISVILLE, KY.—A telephone line between Sharpsburg and Flemingsburg, and taking in the towns of Tilton, Sherburne and Bethel, will be established.

LORAIN, OHIO.—The Central Union Telephone Company has purchased the county toll lines heretofore operated and owned by the Western Reserve Telephone Company.

BAY CITY, MICH.—The Council for the third time declined to grant the Bell Telephone Company permission to erect certain lines of poles, and the company may go to the courts.

EDDYVILLE, IA.—This place is soon to be connected by way of Grinnell with the long-distance copper-metallic telephone. The system will extend to Ottumwa and thence to Centerville.

BEEVILLE, TEX.—The Wade City telephone line is completed to this place and connection made with the Beeville telephone system. Beeville is now connected with the whole of Southwest Texas by 'phone.

FREMONT, OHIO.—Messrs. Ed Barber and Jas. Brailey, Jr., Wauseon capitalists, are forming a company for a new telephone exchange here. Local parties are in the deal. So far the Bell company has had the monopoly.

CHATTANOOGA, TENN.—The East Tennessee Telephone Company has completed and put into operation its long-distance telephone line to Chickamauga and Lytle, Ga., which will prove a great convenience to those living along the line.

KAUFMAN, TEX.—The Southwestern Telegraph & Telephone Company is preparing to put in an exchange here. A telegraph line is being put up from Crandall, on the Texas Trunk, to Kaufman, the line being constructed half the distance now.

LEWISBURG, TENN.—The Cumberland Telegraph & Telephone Company is extending a line from this place to Chapel Hill, via Farmington and Rich Creek, and the Farmington Mill Company will be on the line. All will be connected with the exchange in this town.

BEARDSTOWN, ILL.—The Fulton County Telephone Company will soon have a line operating in this city. This will be the third company having a station here. The line is now complete to Browning and connects with Bushnel, Astoria, Vermont, Canton, Lewistown and other points.

ST. CLAIR, MICH.—An exchange of the new State Telephone Company is about to begin operations here, and the Michigan Bell Telephone Company evinces a disposition to meet every cut in rates. Its representative here has been given instructions to that end, and if need be a $6 a year rate may be given for residences.

WEST POINT, FAYETTE CO., TEX.—The Southwestern Telegraph and Telephone Company has completed its line here from Taylor and established an office. This line connects at Taylor with the long-distance line for S. Louis and other points, and will follow the San Antonio and Aransas Pass Railroad from here to the coast.

DES MOINES, IA.—The first toll line connecting with the Mutual Telephone Company's exchange in this city is now ready for service with the following stations: Valley Junction, Campbell, Waukee, Ortonville, Adel, Dallas

Centre, Minburn, Perry, Kennedy, Redfield, Linden, Panora, Yale, Dawson, Jamaica, Herndon, Cooper, Jefferson, Farlin, Churdan, Lohrville, Woodard, Lake City, Rockwell City, Farnamville, Bonton.

YPSILANTI, MICH.—Connection has been made between Detroit and Ypsilanti on the New State Telephone Company's lines, and a 10-cent toll established between the two cities. The Michigan Bell Telephone Company charges 15 cents for a three-minute talk and 25 cents for a five-minute conversation between Detroit and Ypsilanti. Ypsilanti now has connection with Detroit, Mt. Clemens and Monroe over the New State line.

CARMI, ILL.—Possibly no town of this size has as complete a telephone system or as many instruments in use. This is the headquarters of the White County Telephone Company, which has a capital stock of $25,000 and covers with its lines five of the surrounding counties. This company operates a local exchange of 135 instruments and has thirty-seven toll lines. The general offices are here, with John M. Crebs, president, and Bradford Powell, secretary and general manager.

HUNTSVILE, ALA.—The Georgia & Alabama Long-Distance Telephone Company will soon begin work on the line from Collinsville to Fort Payne, touching Creedup, Seaborn, Keener and other towns along the line. The Southern Bell Telephone Company is considering a line running west from Huntsville, connecting Decatur, Athens, Florence, Tuscumbia, Sheffield and Birmingham. Huntsville will then have a long-distance telephone service extending in every direction.

ELECTRIC LIGHT AND POWER.

BRADDOCK, PA.—Estimates for the erection of an electric light plant are wanted by the engineer at Braddock.

RICHMOND, TEX.—An electric plant will be put in here in the near future. A sufficient amount has been raised and the contract will be let soon.

EDINBURG, ILL.—The Board of Trustees has granted a ten-year franchise to Tipton & Burnett, of Girard, for an electric light system. The plant will be in running order in ninety days.

SPRINGVILLE, N. Y.—There is to be a special election to raise the sum of $6000, with which it is proposed to furnish power for the electric light plant, the water power being insufficient.

JACKSON, MICH.—Chas. Frisbie, of Jackson, is projector of a plan to construct a dam in Trowbridge Township, near Allegan, to generate power, and build a large electric plant to furnish light and heat.

RICHMOND, VA.—Efforts are being made to interest capitalists in a scheme to erect a large plant at Richmond, the power to be obtained from the James River. It is said the scheme is likely to prove successful.

PITTSBURG, PA.—There is a probability that in the near future electric power will be transmitted from the Niagara Falls plant to Pittsburg and Allegheny. The distance over a proposed pole line is 200 miles.

WINONA, MINN.—A new electric light and power company has applied for a franchise from the Winona City Council, and if granted will at once commence work on a plant which it claims will be as fine as any in the country.

ST. AUGUSTINE, FLA.—At the regular meeting of the City Council a communication was read signed by W. A. McWilliams and others, who stated that they were ready to establish an electric light plant in this city upon the receipt of a franchise from the Council.

WEST BAY CITY, MICH.—The Council voted to build a municipal lighting plant, to cost $20,000. The cost will be met by 5 per cent. bonds, 20 years' time, and the contract for the plant was awarded to the F. B. Rae Co., of Chicago. West Bay City has been going dark for months.

WLKESBARRE, PA.—The prison commissioners, who are anxious to curtail expenses, are now talking over the advisability of putting an electric light plant into the county prison, to connect with the court house. Figures as to the cost of such a plant will soon be asked for.

ABERDEEN, MISS.—The incandescent electric-light plant, foundry and machine shops of J. L. Enderton were totally destroyed by fire on July 23. The loss was about $15,000, with only $2000 insurance. The arc-light plant was not destroyed, so the city will have lights on the streets.

TIFFIN, OHIO.—The Tiffin Edison Electric Light Company has commenced work putting in pipes to utilize the exhaust steam from its plant in heating business houses in the central portion of the city. If the plant works well it will be extended to supply residences in all portions of the city.

LANCASTER, PA.—The tests of the six circuits into which the line of the Lancaster Electric Light, Heat & Power Company is divided, which were made recently, having proved entirely satisfactory, the company, which has the contract for lighting the city for the next five years, has commenced its work of lighting the streets.

MARQUETTE, MICH.—A contract has been let by the electric light and power commissioners to the Muskegon Boiler Works to build 2022 feet of steel flume, 6 feet in diameter, to carry water from a dam to the city's electric plant. The amount of the contract is $13,092. The work is to be done by January 1. The commissioners have lately been empowered to issue $35,000 in bonds, and the contract let calls for the first expenditure of that money in the scheme to build a new dam and double the present power of the plant.

NEWARK, N. J.—Mr. Philip N. Jackson, president of the Peoples Electric Light & Power Company, of this city, is authority for the statement that that company and the Newark Gas Company will probably be consolidated within a month. The deal will be completed, it is stated, upon the return from Europe of Mr. Henry C. Kelsey, president of the gas company, and others interested. The Peoples Electric Light & Power Company recently issued 18,100 new shares, bringing its capital stock up to $5,000,000. It has no bonds. The Newark Gas Company has a capitalization of $1,000,000, and has $4,000,000 in bonds. The consolidation of the two concerns will put under one control nearly all the important light and power plants in Northern New Jersey.

THE ELECTRIC RAILWAY.

MANKATO, MINN.—Bankson Taylor, of St. Paul, is interested in a stock company organized to establish an electric road in Mankato.

AMERICUS, GA.—There is a well-directed movement to establish an electric street railway in Americus. Prominent citizens are interested in the enterprise.

NEW HAVEN, CONN.—The Milford Company secured a charter from the last Legislature to construct an electric railroad from the Housatonic River to Woodmont.

McHENRY, ILL.—The Board of Supervisors has granted Windsor, Williams & Luck a franchise to build an electric road from McHenry to Lake Geneva. Work will commence at once.

BOSTON, MASS.—At the next meeting of the Dedham Selectmen a location will be asked for by the promoters of an electric railway to be run from Dedham through Westwood to Medfield.

CLINTON, MASS.—The selectmen gave a hearing to the Worcester & Clinton Street Railway Company petitioning for a franchise to lay electric railway tracks from Lancaster Mills bridge to the Boylston town line.

PAWTUCKET, R. I.—General Manager E. P. Shaw, Jr., of the Pawtucket Valley street railway, recently stated that this fall he intended to examine the route for a possible extension of the present tracks of the company to Ashaway.

PUEBLO, COL.—A consolidation of the electrical interests in this city has been consummated. Two companies will be maintained, a street car company and a light and power company, but both will be under the management of the same officials.

WALTHAM, MASS.—The Newton Street Railway Company is arranging to ask at an early date for the necessary franchise for a line from Waltham to Waverly and Belmont, with a view to ultimately extend the same to Cambridge, to a connection with the West End Road.

NASHVILLE, TENN.—The Birmingham, Powderly & Bessemer Street Rail way stockholders have voted $40,000 for improving the road, and the Birmingham Railway & Electric Company is spending a like amount, converting its Pratt City steam dummy line into an electric railway.

AKRON, OHIO.—The Akron Street Railway Company has been granted a franchise for a double track between this city and Cuyahoga Falls. Cars will be run at frequent intervals. In consideration of the franchise the company agrees to make extensive improvements in the roadway.

NEW BRUNSWICK, N. J.—At the meeting of the Middlesex County Board of Freeholders in New Brunswick, the franchise granting the New Brunswick Traction Company the privilege of crossing the Albany Street bridge spanning the Raritan River was adopted without a dissenting vote.

MILWAUKEE, WIS.—The Milwaukee Electric Railway & Light Company, yielding to the public demand, will not erect trolley poles in the centre of Grand Avenue, between Eighth and Tenth Streets, as contemplated, but will place them on the sides of the street, so that the view of the Washington monument will not be obstructed.

DERBY, CONN.—An operating syndicate for electric street railways has been formed, with Mr. C. H. Davis, of New York City, at its head. The purpose of the combine is not to buy and sell trolley roads—only to operate them. D. B. Porter, of the Derby Street Railway, is to become the general manager for the syndicate. The system is expected to reduce operating expenses.

LIMA, OHIO.—A company is at work taking up the right of way for an electric railroad to connect this city with Bellefontaine. The proposed line will run through Westminster, Waynesfield, New Hampshire, Lakeview, Lewiston and thence to Bellefontaine. There is a company at the head of the enterprise with an abundance of capital, and it is thought that the line will be built at an early date.

UNIONTOWN, PA.—The Uniontown Street Railroad has been recently reorganized and is now running under a new management. It is proposed to overhaul the road completely, putting on new cars and extending the lines north of Uniontown for a distance of 3 or 4 miles. The company has prepared specifications covering the changes and is prepared to receive bids for the same.

CLEVELAND, OHIO.—The new system of carrying mail on the suburban electric traction lines has been tried for a week and its success has been satisfactorily demonstrated. Four mails per day have been carried on the electric cars from Painesville, as well as from Mentor, Willoughby and other intermediate points. A closed pouch service to Elyria and intermediate points over the Cleveland & Elyria electric railroad has also been inaugurated. Later on a regular postal car will be put upon the line. The postal service may be introduced on the Akron, Bedford & Cleveland road.

MILWAUKEE, WIS.—The plans of the Milwaukee Electric Railway & Light Company for the immediate future, as well as for next season, have been practically formulated, and they provide for the outlay of about $1,000,000 in cash. The programme includes the construction of an electric line to Waukesha, the absorption of the Waukesha Beach electric line, an extension from the beach to Oconomowoc, the building in Milwaukee of one of the largest and most complete power houses in the country, and the construction of a complete electric system from Milwaukee to Whitefish Bay. All these improvements will be completed and in full operation by May 1, 1898.

LEGAL NOTE.

DECISION IN AN ELECTRIC CAR-HEATER CASE.—The information is received that on August 2 Judge Wheeler, of the United States Circuit Court for the Second Circuit, rendered a decision in favor of the defendant in the case of the Burton Electric Company against the Union Railway of New York, which was defended by the Consolidated Car-Heating Company. This decision, it is stated, settles the right of the Consolidated Company to use the multiple-series system of wiring with its electric heaters.

Personal Notes.

MR. GODFREY MORGAN, formerly general manager of the Amsterdam Street Railroad Company, Amsterdam, N. Y., has accepted the position of superintendent of the Buffalo, North Main & Tonawanda Street Railway Company. Mr. Morgan's headquarters will be in Buffalo. His past experience in the street railway field will constitute a valuable factor in the operation of the latter named railway.

MR. C. C. HASKINS, who for the past thirteen and a half years has been connected with the electrical department of the City of Chicago as electric light inspector, having severed that connection, has opened an office in room 623 Western Union Building, Chicago, as an electrical expert. One of the oldest telegraphers, one of the earliest telephone electricians and superintendents, and having been well schooled in electric lighting, Mr. Haskins should be thoroughly competent to engage in his new duties.

Obituary Notes.

STEPHEN MONTAGUE CANTY, an electrician for the Southern New England Telephone Company, was found dead at his apartments in New Haven, Conn., on August 5. It is thought that his death was due to heart disease. Mr. Canty was thirty-six years of age, and was quite well known as an electrical expert. It is said that he installed the first telephones used in Cuba. He was an inventor of some ability.

JAMES W. McDONOUGH, who figured conspicuously in the courts a few years ago as a litigant against the Bell Telephone Company, over the question of priority of invention of the telephone, died at Chicago on July 20. Mr. McDonough was born in St. Louis on May 5, 1845. As early as 1867, it is stated, he constructed an electrical instrument which was practically the same as the telephone of to-day. McDonough claimed that by reason of illness he lost his invention in allowing his application to rest in the Patent Office. His researches covered many branches of science, and latterly he devoted much of his attention to the subject of color-photography. Mr. McDonough was a man of exceptional ability. Personally he was genial, and was highly esteemed by all who knew him.

Trade and Industrial Notes.

LARGE DEMAND FOR ENCLOSED ARC LAMPS.—The Electric Arc Light Company, New York, reports that the outlook for the fall trade in arc lights is promising very well. It has sold in one week over 500 of its Pioneer enclosed arc lamps.

AMERICAN MACHINES IN CHINA AND JAPAN.—Mr. F. W. Horne, who is now on his way to Yokohama, Japan, has placed a large order for lathes, planers, shapers, milling machines, etc., with the Davis & Egan Machine Tool Company, Cincinnati, Ohio. He will represent that company in China and Japan.

MACHINE TOOLS FOR THE GOVERNMENT.—Bids were opened by the United States Government on Tuesday, August 3, for a large equipment of machinery for the Navy Yard at Port Royal, S. C. The Davis & Egan Machine Tool Company, Cincinnati, Ohio, was awarded the contract for several of the machine tools.

INCANDESCENT PLANT WANTED.—The Elkin Manufacturing Company, Elkin, Surry Co., N. C., is in the market for a new or first-class second-hand 300 or 400-light incandescent dynamo, with switchboard, wire, lamps, etc., for the purpose of lighting the town of Elkin. The company wishes to light the streets with 100 16-cp lamps, the rest to be used in stores and residences.

HOME INDUSTRY WINS.—Messrs. Schminke & Newman, electrical contractors, New Orleans, La., have secured the contract to do the wiring and install the electrical appliances in the new annex of the St. Charles Hotel in that city. There were fourteen competitors for the contract, and the business men of New Orleans are congratulating this energetic young firm on its success. Iron-armored conduit of the Interior Conduit & Installation Company, New York, will be used in this installation.

MESSRS. T. N. MOTLEY & CO., 43 John Street, New York, announce that they have added an electrical department to their business and carry a complete line of materials for the construction and maintenance of street railways, lighting and power plants, telephone and telegraph systems, in connection with steam railroads and general power transmission. This department has been placed in the charge of Mr. Joseph Keefe, late with the Westinghouse Electric & Manufacturing Company and The E. S. Greeley & Co.

OPENED A WAREHOUSE IN BROOKLYN.—Messrs. J. Jones & Son, the well-known electrical supply dealers, New York City, have opened a large warehouse in Brooklyn, N. Y., in which is stocked one of the largest assortments of slate—plain, enamelled and marbleized—that can be found in the vicinity of New York. This firm represents one of the largest Vermont quarries, and while the smallest piece in stock is 1½ x 3¼ inches, and the largest 6 x 4 feet, it can at short notice deliver slate of any dimensions.

WINDOW REFLECTORS.—I. P. Frink, New York City, the well-known manufacturer of window reflectors, has received a letter from Messrs. L. S. Plaut & Co., the proprietors of the large department store in Newark, N. J., known as "The Bee Hive," in which an excellent word is spoken for these reflectors. Plaut & Co.'s windows are equipped with Frink's reflectors, and in their letter the firm state that the reflectors "have given entire satisfaction, the lighting being very fine." They close by saying that they can highly recommend the reflectors.

LONG-LIFE INCANDESCENT LAMPS.—The behavior of the incandescent lamps of the Allgemeine Electricitats Gesellschaft greatly pleases that concern's agents in this country, Messrs. Machado & Roller. Of a large lot put in service last March the average life to date is approximately 3000 hours, and this average, of course, is increasing every day. The current consumption of this lot is also gratifyingly low. Messrs. Machado & Roller attribute these results to the care taken by the A. E. G. in its lamp works, which have, by the way, a capacity of 50,000 lamps per day. In spite of the 60 per cent. ad valorem duty on lamps, Messrs. Machado & Roller expect to compete in price as well as in quality with domestic makes.

THE SWARTS SWITCHBOARD AND ELECTRIC COMPANY, Knoxville, Tenn., which was recently organized, is now bidding for business. It invites telephone companies to investigate its switchboards and telephones, which, it claims, are the most efficient on the market. Its system, it is stated, has passed beyond the experimental stage, and is now a commercial success. The system is in use by the People's Telephone & Telegraph Company, one of the largest independent telephone companies in the South. Mr. Duncan, the manager of the telephone company, who is also a member of the Advisory Board of the National Telephone Association, says he could not operate his exchange satisfactorily without the Swarts equipment.

PAPER-INSULATED CABLES.—The Standard Underground Cable Company, Pittsburg, Pa., is sending out a circular letter to the interested trade in reference to the claim made by another company as to its exclusive monopoly of paper-insulated electric cables and wires. The Standard Campany announces that it has been manufacturing and selling wires of this kind for many years, and that its counsel advises that there is no doubt whatever as to its right to do so. It is prepared at any and all times, it states, to defend at its own expense any suit or suits brought for infringement against anyone purchasing from it such wires and cables. It asks to be promptly notified of such suits and to be allowed an opportunity to make a defense therein.

A CONVENIENT TELEPHONE INSTALLATION.—An intercommunicating metallic-circuit telephone system has been recently installed in the Central National Bank, New York City, by the Wilson-Bates Electric Company, New York. This installation is said to be one of the finest of the kind in the city, if not in the United States. There are thirteen stations connecting the principal departments. At the desks of the president and directors there is a floor-contact plug, with thirty-six contacts, so arranged that the telephone cable can readily be detached, thus permitting the desks to be moved at pleasure. The hole may be closed by a piece of wood of the same color as that of the of the floor. All the batteries, including the local batteries, are situated at one point in the cellar, so that in case of trouble it may be easily remedied.

TERRA-COTTA CONDUITS.—The "Mason" terra-cotta duct for electric wires is evidently coming to the front. It was devised in 1895 by Mr. George Mason, of Washington, D. C., and is being marketed by the Potomac Terra Cotta Company, 36 Corcoran Building, Washington, D. C. The first Mason duct was laid down in that city in 1896 by the Postal Telegraph Cable Company, and by the Chesapeake & Potomac Telephone Company later on. They are said to be giving entire satisfaction and experts commend them. These conduits are made in two and four-way ducts, the sections being joined together by dowels of wood or other material, a small central opening in the four-way duct serving to carry a return wire. The two companies above named speak highly of these conduits. Electric light and electric railway companies will be interested to look into the merits of the "Mason" duct.

STOPPING INFRINGERS.—The Phoenix Carbon Manufacturing Company, St. Louis, which last January purchased of the Law Battery Company patent No. 450,234, dated June 27, 1893, coveringg a carbon screw connection for galvanic battery cells, some time ago brought suit against the National Carbon Company for infringement of the patent, and at the same time asking for a restraining injunction This was granted on June 29, and the Phoenix Company is now pressing the suit to obtain judgment. Colonel Booker, superintendent of the Phoenix Carbon Manufacturing Company, says his company will certainly stop not only the National Carbon Company, but all other infringers of the patent, and will be prepared in a short time to supply the entire trade for this type, as well as all other types of galvanic batteries. The Phoenix Company has enlarged its factory and is now prepared to fill orders for complete batteries or any of their parts.

SOME GOOD ORDERS.—The Ahlm-Edwards Electric Company, Cleveland, Ohio, is doing an excellent business, and feels the tide of returning prosperity. This is indicated by the number of orders recently taken by the company, among which may be mentioned the following: One 17½-kw, 125-volt, 825-r. p. m. generator for Chase & Sanborn, Chicago; one 7½-hp, 500-volt, 1400-r. p m. elevator motor, and one 15-hp., 500-volt, 1200-r. p. m. elevator motor for Edmonds Elevator Company, Cleveland, Ohio; one 5-hp, 220-volt, 1000-r. p. m. elevator motor for the Enterprise Printing Company, Cleveland, Ohio; one 3-hp, 220-volt, 1100 r. p. m. motor for W. Plotz, Cleveland, Ohio; one 42-kw, 250-volt, 850-r. p. m. generator for the Enterprise Boiler Company, Youngstown, Ohio; one 7½-hp, 220-volt, 700-r. p. m. elevator motor for the Britton Printing Company, Cleveland, Ohio; two 1-hp, 220-volt, 1300-r. p. m. motors and one 2-hp, 220-volt, 1200-r. p. m. motors and two 3-hp, 220-volt, 1100-r. p. m. motors for the A. S. Gilman Printing Company, Cleveland, Ohio; two 1-hp, 220-volt, 1300-r. p. m. motors and two 2-hp, 220-volt, 1200-r. p. m. motors for the Britton Printing Company, Cleveland, Ohio.

"BIG BOILERS" is the title of a cleverly written twenty-two page brochure just issued regarding the Cahall and Babcock & Wilcox types of boiler. The Cahall boiler has been manufactured for about five years by the Aultman & Taylor Machinery Company, Mansfield, Ohio. It was found to be an excellent boiler for electric railway and electric lighting plants. Some stations, however, where the ceilings of the boiler rooms were not of unusual height were unable to use the Cahall boiler on account of having too little head room for the vertical tubes. To meet this objection the Aultman & Taylor Machinery Company began the manufacture of the Babcock & Wilcox type of boiler, which, having tubes on a slant, can be put in places where the Cahall boiler is unavailable. The pamphlet explains the difference between the two boilers, saying that the Babcock & Wilcox type has been in use for thirty years, and is an excellent boiler of its kind, though the company recommends the Cahall in preference where there is enough head room to permit of its use. There has been a vigorous competition for some little time between the Cahall boiler and the boiler manufactured by the Babcock & Wilcox Company, and purchasers of boilers seem to be the gainers. The pamphlet states that "five years ago the Babcock & Wilcox Company's boilers sold for $17 per horse-power; to-day $6!"

AN ISOLATED PLANT FEED-WATER TEST.—A fact that is often forgotten is that every steam boiler is in one sense a mammoth still. All steam leaving it is pure distilled water; and any feed water entering it less pure than distilled water is sure to leave a sediment in the boiler. When the new Woodbridge Building was erected on William Street, New York City, its equipment included an Excelsior feed-water heater, purifier and oil separator. Soon after the plant was put in operation, and while the exhaust of engines and pumps and the drip from the heating system was being turned into the heater, a sample of the purified feed water was drawn and sent to a chemist to be tested for the presence of oil. The report showed the presence of one-twenty-fifth of one grain of oil per gallon of water. Mr. John M. Duncan, 30 Cortlandt Street, the New York agent of the Harrisburg Pipe-Bending Works, makers of filters, has figured out that, as a gallon of oil weighs about 50,000 grains, it would take 1,250,000 gallons of feed water to introduce into the boiler 1 gallon of oil. This result is quite remarkable, as the feed water is heated by direct contact with the exhaust steam; and quite effectually disproves the statements made by the advocates of pressure heaters, that direct heating endangers the boiler by the return of cylinder oils in the feed water.

ENAMEL RHEOSTATS.—It is five years since the first enamel rheostats were placed upon the market by the Ward Leonard Electric Company, Hoboken, N. J., and the rapid expansion of the business is evidenced by the size and scope of the new catalogue of enamel rheostats just issued by that company. Greater attention to utility than to mere appearance has been given in the production of this catalogue. It is well illustrated with views of the various types of apparatus made by this company, together with diagrams showing construction details. The principle and advantages of the Carpenter enamel rheostat are well presented to the reader. The devices covered by the catalogue include field rheostats of all capacities, the Ward Leonard enamel rheostat, motor-starting rheostats, automatic rheostats, Universal automatic rheostats, for starting motors; automatic circuit breakers, ventilating-fan speed regulators, theatre dimmers, motor-regulating rheostats, reversing controllers, Standard resistance plates, etc., etc. A feature is the telegraph code, which enables a foreign buyer to order any desired rheostat with complete accuracy by the use of a single code word, or catalogue number. A very useful table of equivalents for electric-heating problems, is also given. The Ward Leonard Electric Company has standardized many hundreds of rheostats for use as field regulators, motor starters, theatre dimmers, ventilating fan regulators, etc. We notice a marked reduction in the price of all the company's goods. The company is represented in England by Veritys, Limited, and in Berlin by S. Bergmann & Co. Its foreign business, we are informed, is very large and rapidly increasing. This, the company attributes largely to the comprehensiveness of its catalogues, and its latest production in this line gives evidence that this belief is not unwarranted.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 3, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

587,311. REGULATING ADMISSION OF CURRENTS TO MOTORS; F. E. Herdman, Winnetka, Ill. App. filed Nov. 27, 1896. The combination with an electric motor, a source of current supply, electrical connection between the field and armature of the motor and source of supply, of a current-regulating device adapted in its movement to vary the amount of current passing to the motor, means connected with and operated by the motor to normally control the position of the current-regulating device, a switch for admitting current to the motor and a device connected with said switch adapted to render said means ineffective to move said current-regulating device during the closing of the switch.

587,336. TELEGRAPHY; F. M. Short, Cleveland, Ohio. App. filed April 9, 1896. In a system of telegraphy, and as a means for transmitting facsimile messages, designs or the like, prepared in conducting material, a transmitting instrument, comprising insulated points, one of said points included in circuit with a source of current and the other included with the line-wire, the circuit between said points to be closed by the conducting material composing the message design or the like to be transmitted, a receiving instrument comprising a vibrating recording style, and means energized by the current of the line circuit for vibrating said style.

587,340. OPERATING ALTERNATING MOTORS; C. P. Steinmetz, Lynn, Mass. App. filed Nov. 23, 1893. The method of operating alternating-current motors, which consists in feeding alternating currents to one member of one such motor from a source of power supply, converting the energy so supplied to the motor partly into mechanical energy expended in driving a driven mechanism, and partly into electrical energy in the form of alternating currents induced in the secondary element of the motor, and supplying a second alternating motor with the said secondary currents.

587,379. DYNAMO-ELECTRIC MACHINE; E. P. Warner and H. H. Wait, Chicago, Ill. App. filed June 3, 1896. In a dynamo electrical machine, the combination with an armature, of a pole piece cut away or slotted to leave constricted necks or paths for the passage of the main field lines of force, said necks or paths being so proportioned that the metal thereof will rise to a point near saturation during the normal operation of the machine to prevent the formation of a local field through the pole pieces due to the armature coils.

587,405. SIGNAL FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed Aug. 1, 1895. In combination, two terminal plugs of a pair and the plug current thereof, means for connecting a generator of signaling current with one of the plugs, a bridge of the plug circuit, a source of current and a signal in the bridge, and another signal included in a conductor of the plug circuit between the said bridge and that plug with which the generator of signaling current may be connected.

587,406. APPARATUS FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed Dec. 18, 1896. The combination with a telephone line, a source of current in the line and means at the sub-station for determining the flow of current consequent on the use of the telephone, of a line signal associated with the line in the central office and controlled by currents in the line, a relay adapted to break the circuit through the said signal when excited, a local circuit including said relay, and means for closing the said local circuit in the act of making connection with the line, whereby the line signal is effaced when connection is made with the line.

587,421. ELECTRIC ARC LAMP; S. Bergman, New York, and E. Lavens, Brooklyn, N. Y. App. filed Feb. 7, 1896. In an arc lamp, and in combination with the light carbons, a globe closed at the bottom and having an aperture at the top, and a cap for said aperture adapted to fit the upper carbon, and provided with a depending flange slightly smaller in diameter than the aperture, thus serving to permit lateral play of the carbon, while holding said cap in place.

587,433. ELECTRIC SIGNALING APPARATUS; M. Du Perow, Washington, D. C. App. filed July 10, 1895. A normally open partial speaking circuit having in it a telephone, or the primary and secondary coils thereof, and an independent normally open partial signal-transmitting circuit having in it a source of electricity only, in combination with an independent partial signal-receiving circuit having in it a signal and being normally closed by a switch adapted when moved in one direction to successively open the signal receiving circuit, close and then open the signal-transmitting circuit, and finally close the speaking circuit, and when moved back again to reverse these operations.

587,435. AUTOMATIC TELEPHONE SYSTEM; M. Freudenberg, Paris, France. App. filed Oct. 22, 1896. An automatic system of telephone switching in which the station of each subscriber is connected with a central-office switch divided into as many sectors as there are groups of subscribers, and in which each sector of said central office is connected with a carriage that passes over strips connected respectively with the subscribers' lines and is arranged to put itself in electrical connection with any given strip according to its position, the exchange being thus divided into groups, in each of which there are as many carriages as there are subscribers to the exchange, and as many strips as there are subscribers in that group.

587,436. ELECTROTHERAPEUTIC APPARATUS; F. Geiger, Philadelphia, Pa. App. filed May 13, 1897. In an electrotherapeutic apparatus, a main circuit, a patient or operator circuit, a fixed resistance in series with the operator circuit and a variable resistance in the main circuit and in shunt with the patient or operator circuit.

587,441. REGULATING APPARATUS FOR ELECTRICALLY DRIVEN MECHANISM; W. H. Knight Newton, and W. B. Potter, Lynn, Mass. App. filed May 21, 1892. In an apparatus for regulating the power and speed of mechanism driven by two electric motors, the combination of two electric motors and a switch connecting them in series with each other and with a resistance, the switch provided with contacts and connections arranged to shunt one motor, leaving the other in series with a resistance, to disconnect one motor and to connect the two motors in multiple, all by successive steps.

587,442. METHOD OF REGULATING ELECTRICALLY DRIVEN MECHANISM; W. H. Knight, Newton, and W. B. Potter, Lynn, Mass. App. filed May 21, 1892. The method of regulating the power and speed of mechanism driven by a plurality of electric motors, which consists in first coupling the motors in series, then shunting a part of the motors and protecting the remaining unshunted part thereof from the increased voltage delivered thereto by, for example, an external resistance, and finally reconnecting the motors in multiple.

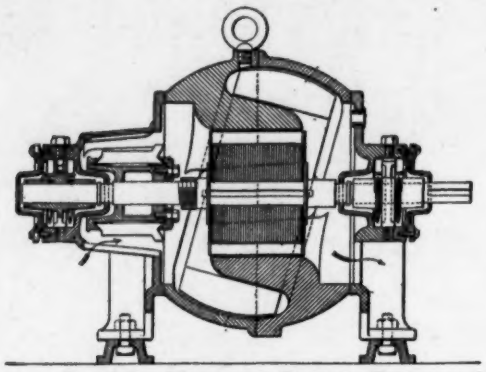
587,465. ELECTRIC ARC LAMP; E. F. Taylor, West Chester, Pa. App. filed March 18, 1896. A chimney for electric arc lamps having in combination a plate adapted to close its top, said plate having orifices symmetrically disposed about its centre, a chamber into which said orifices open, an escape passage leading from said chamber to the air, and means for closing the bottom of the chimney adapted to have only a contracted opening thereto.

587,467. TELEPHONE CENTRAL STATION SIGNALING CIRCUIT; G. K. Thompson, Malden, Mass. App. filed May 25, 1897. The combination in a telephone central station apparatus, of a series or group of connecting cords or conductors, a corresponding series of disconnecting lamp signals, a shunt circuit round each signal, an electromagnetic switch controlling each shunt circuit, and a common supplementary or pilot signal in an auxiliary local circuit, with a relay controlling such auxiliary local circuit and pilot lamp,

and wound with a plurality of exciting coils associated with the said cords and disconnecting signals respectively, the said coils or windings being each connected in parallel with its associated lamp, and sustaining like relations with said lamp to the shunt circuit thereof and its controlling switch.

587,502. CENTRAL-OFFICE SWITCHBOARD SYSTEM; W. S. & E. M. Harrison, Chicago, Ill. App. filed March 30, 1895. The combination with the switchboard, of a spring-jack switch, constructed with an elongated frame composed of a line-wire shoe, having a front-socket face plate, and of an annunciator spring bowed upward or outward near its front end, and secured at its rear end to the rear end of said shoe, the parts being separated by insulating material, a ground lug secured to the switchboard above said shoe, and having an arm passing under the bowed portion of said spring and serving to support it, and a switch plug, whereby the plug may be inserted in the switch jack, in contact with the spring, without making contact with said ground lug.

587,507. ELECTRIC SIGNAL DEVICE FOR ELEVATORS; O. Raacke and G. Hensel, St. Louis, Mo. App. filed March 11, 1897. In an electric signaling device for elevators, a vertically movable spring plate, having a



No. 587,531.—ELECTRIC MOTOR OR DYNAMO-ELECTRIC MACHINE.

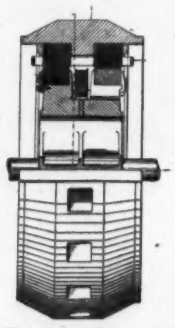
bulging portion forming a part thereof, a plane extension forming a continuation of the bulging portion and having a cut-away portion or opening, circuit-closing devices normally projecting through said opening, a suitable source of electrical energy and means for shifting the movable plate and bringing the solid portion thereof in contact with the said circuit-closing devices as the elevator approaches a landing.

587,531. ELECTRIC MOTOR OR DYNAMO-ELECTRIC MACHINE; R. Lundell, Brooklyn, N. Y. App. filed Dec. 15, 1896. An electric motor having a rotary armature and a field magnet composed of duplicate or interchangeable parts with overlapping field-magnet poles surrounded by an energizing coil inclined at an angle to the axis of the armature and permitting of removal thereof without disturbing the field magnet.

587,534. ELECTRICAL ALARM FOR CARS; A. Nathan, New York, N. Y. App. filed June 8, 1897. An electric alarm for cars, said alarm consisting of a vertical shaft, a spring-supported lever pivotally connected with the upper end thereof and provided with a downwardly directed arm, a vertically movable disc or plate mounted on said shaft below said lever, a disc or plate mounted below said vertically movable disc or plate, and connected and vertically movable therewith, a disc or plate rigidly secured to said shaft below said last-named disc or plate, and an alarm bell in electrical connection with said last-named discs or plates.

587,573. DYNAMO-ELECTRIC MACHINE; V. A. Flynn, Erith, England. App. filed Aug. 3, 1896. In a dynamo-electric machine, the combination with an armature, of a field magnet having its poles arranged alternately in different planes, each pole embracing a section or portion of the armature lengthwise of its axis, one portion or section of the armature being acted upon by south poles only and the other by north poles only, so that the magnetic flux through each section of the armature varies its intensity without reversing its direction therein.

587,565. ELECTRIC SIGNAL BOX; A. T. Whittlesey and F. B. Dodge,



No. 587,573.—DYNAMO-ELECTRIC MACHINE.

Cleveland, Ohio. App. filed June 18, 1896. In an electrical signal box or signaling device, the combination with a series of electromagnets, of a magnetic yoke extending along the entire series of magnets and constituting a single permanent magnet, magnet cores having an enlarged surface at one end, reduced body portions, and further-reduced end portions rigidly secured within said permanent magnet, and an armature provided with a trip or lock mechanism rigidly secured to said armature and actuated thereby.

587,576. DYNAMO-ELECTRIC MACHINE; C. M. Green, Cleveland, Ohio. App. filed Nov. 10, 1896. In a multipolar dynamo machine, the combination with a series of commutator rings, of armature coils connected with commutator segments at the same side of the armature at which the coils are located, and several sets of commutator brushes to engage said commutator rings.

587,593. TELEPHONE TRANSMITTER; O. Moran, New York, N. Y. App filed Dec. 22, 1896. In a telephone transmitter, the combination with the casing, the cap fitted thereon having a suitable mouthpiece, and with the diaphragm between said casing and cap, of the carbon block with the casing having a central hole extending therethrough for the reception of granules of carbon or other conducting material in a loose state, a set-screw extending through the bottom of the casing upwardly into said hole of the carbon block to form a support and adjusting medium for the loose granules, and a carbon pencil extending downwardly from the diaphragm into said hole of the carbon block to contact with granules.

587,594. ELECTRIC CONTACT; A. J. Moxham, Lorain, Ohio. App. filed Jan. 28, 1897. In an electric contact box, a metallic cover plate, having a perforation and upward projections on each side thereof, in combination with the contact secured in said perforation, but insulated from said projections.

587,614. ELECTRIC WIRE HOLDER; C. J. Stram, Waterman, Ill. App. filed May 27, 1897. A holder, consisting of a piece of rubber or analogous material, provided with an opening therein and a support for said holder, having embracing tongues and a supporting lip.

587,625. AUTOMATIC SWITCH MECHANISM; J. E. Tryon, Detroit, Mich. App. filed Feb. 23, 1897. The combination with a switch lever and means for operating it manually, of a power-driven crank arranged to rotate in the path of the switch lever for operating the same, an escapement controlling said power-driven crank, stop for said escapement and an electrically controlled tripping device for said stop.

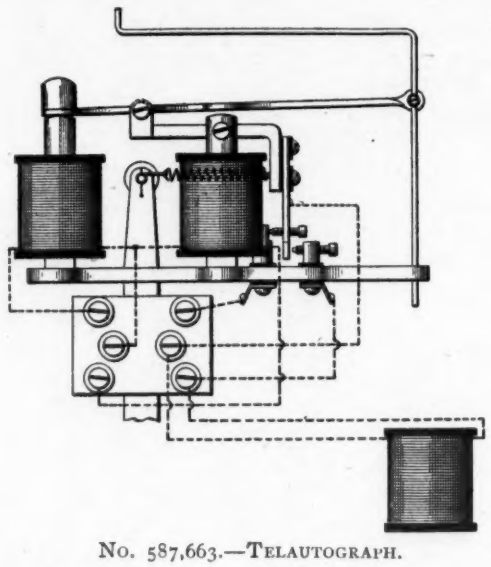
587,642. ELECTRIC CONTACT BOX; W. M. Brown, Johnstown, Pa. App. filed Sept. 30, 1896. A switching mechanism for electric contact boxes, comprising the combination with a fixed contact and a contact-carrying armature, of a spring encircling and secured to said armature and to a fixed portion of the mechanism.

587,649. ELECTROCUTION CHAIR; E. F. Davis, West Caton, N. Y. App. filed Jan. 6, 1897. A chair, having in combination with means for passing an electric current through a person seated therein, a foot-rest, a seat, registering the weight of an individual, and an adjustable back.

587,654. TELEPHONE TRANSMITTER; O. A. Enholm, New York, N. Y. App. filed Nov. 17, 1896. In a telephone transmitter, the combination of two electrodes and a composition of an adhesive elastic substance intermixed with conducting material, interposed between the same.

587,663. TELAUTOGRAPH; G. S. Tiffany, Highland Park, Ill. App. filed June 7, 1895. In a telautographic apparatus, the combination of two magnets, one for raising and one for lowering the receiving pen, a circuit maker and breaker controlled by said magnets when operated simultaneously, and a paper-feeding mechanism controlled by the said make and break.

587,669. BURGLAR-ALARM SYSTEM; W. T. Arnold, Chicago, Ill. App. filed Dec. 15, 1896. In a burglar-alarm system, the combination of a subscriber's station, having protecting conductors or apparatus connected with the central office, with a resistance at the subscriber's station in circuit with said conductors or apparatus, a relay at the subscriber's station for removing said resistances, a source of electricity and a resistance at the central office in circuit with said relay, automatic means at the central office for removing said resistances periodically, and suitable indicating apparatus



No. 587,663.—TELAUTOGRAPH.

at the central office adapted to respond to a change in the circuit condition at the subscriber's station.

587,674. ELECTRIC RAILWAY; R. M. Hunter, Philadelphia, Pa. App. filed (original) July 14, 1885, divided and re-filed Oct. 1, 1891. In an electric railway, the combination of a bared working conductor extending along the railway and divided into two or more sections insulated from each other, an insulated supply conductor buried or arranged below the level of the track and connected at intervals with the sections of working conductor, a return circuit, and a source of electric energy for supplying current to the insulated supply conductor and return circuit.